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K.W. Owens

See reverse side for additional approvals

Abstract

The 224-B Concentration Facility is scheduled to be decommissioned during the FY 1985 through FY 1987 time period. The purpose of the project is to remove the process-related piping and equipment, decontaminate the facility and return approximately 30,000 ft^2 of building to beneficial use. The building will radiologically be considered a controlled facility at the end of the project.

The project is estimated to cost $3.1 million and will be completed in FY 1987.

*	Distribution Name	Mail Address
	Department of Energy	
*	C.E. Miller, Jr.	Fed Bldg/700
*	J.H. Slaughter	Fed Bldg/700
	Rockwell Hanford Operations	
*	M.R. Adams	2750E/200E
*	D.M. Craig	2752E/200E
*	J.C. Fulton	2750E/200E
*	B.J. Fuquay	MO-317/200E
*	R.D. Gaines	271B/200E
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*	W.F. Heine	2750E/200E
*	R. Jacobs	2751E/200E
*	R.J. Jensen	2751E/200E
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*	G.E. McPherson	222T/200W
*	G.G. Meade	2751E/200E
*	C.C. Meinhardt	2750E/200E
*	S.Y. Okawa	2752E/200E
*	K.W. Owens (3)	2750E/200E
	R.D. Prosser	2750E/200E
*	O.R. Rasmussen	2750E/200E
	J.H. Roecker	2750E/200E
*	R.A. Rowell	2750E/200E
*	R.D. Silvey	MO-317/200E
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Approvals

[X] Program Office W.F. Heine

[X] Research and Engineering M.R. Adams

[X] Plant Operations A.N. Gallegos

[X] Health, Safety and Environment R.J. Jensen

[ ] Quality Assurance

[ ] Training

[ ] End Function

[ ] End Function

[ ]

[X] R.A. VanMeter

[X] D.R. Speer

[ ]

[X] Approval Authority C.C. Meinhardt 5/24/85

* Distribution	Name	Mail Address
*	D.R. Speer	2750E/200E
*	R.A. VanMeter	2750E/200E
*	D.D. Wodrich	2750E/200E
*	Publication Services (2)	2750E/200E

EXECUTIVE SUMMARY

The 224-B Decontamination Project will reduce or eliminate the radiological hazards in 224-B and make 30,000 ft^2 of building available for beneficial reuse. The project scope includes isolation of the building from potential radioactive contamination sources, removal of a portion of the vessel ventilation tunnel, removal of equipment, and decontamination of the building.

The 224-B Concentration Facility was used in conjunction with B Plant from 1944 to 1952. It provided concentration and further decontamination of the plutonium product that was separated from reactor fuel in B Plant. Since 1952, parts of the building have been used on occasion for shop space and storage.

The concrete and concrete block building contains a first and second floor with approximate dimensions of 190 ft by 60 ft and a third floor of 145 ft by 60 ft. Half of the building was used for offices, a pipe gallery, and an operating gallery. The other half of the building was divided into five interconnected cells and one separate cell.

Radiological characterization of the facility indicates that essentially all of the contamination is contained in the cells. This amounts to about 31 Ci of plutonium (505 g), 5.2 Ci of americium, and 26 Ci of fission/activation products. Because of the low radionuclide inventory, especially fission/activation products, exposure will not be a problem during this project.

The total project is estimated to take 3 years to complete at a cost of $3.1 million. The activities in FY 1985 include preparation of this project plan, the environmental documentation, and a safety analysis report.

Work on the facility will begin in FY 1986. During the first quarter, the building will be prepared for the dismantling and decontamination. This involves the upgrade, testing, and modification of utilities and equipment such as the canyon crane. Following the building preparation, decommissioning and decontamination work will commence on the pipe and operating gallery where contamination potential is low. Piping, tubing, panelboards, and tanks will be removed from the galleries.

After the gallery decommissioning, cells A through E will be stripped of equipment and piping. As waste is removed, it will be assayed for transuranic (TRU) content and packaged for disposal as low-level waste or for storage as TRU waste.

Decontamination of the building surfaces in A through E cells is scheduled for the first part of FY 1987. The surfaces will be cleaned or removed to leave only fixed contamination with very low dose rates.

The cell ventilation system will be disconnected from A through E cells after the cells are decontaminated and reconnected to F cell. The same sequence (removing equipment and piping, then decontamination) will be followed in F cell.

After the building is decontaminated, it will be made safe to leave in standby. Openings created through walls and floors will be closed and the utilities returned to normal services.

The air tunnel that lies parallel to the cells will be excavated and removed. The concrete and clay tunnel will be cut into sections and disposed of in a low-level waste burial ground.

Project closeout will include the preparation of a closeout report, and the preparation of engineering orders to modify the facility drawings to reflect the final facility condition.

CONTENTS

1.0 INTRODUCTION

1.1 BACKGROUND

The 224-B Plutonium Concentration Facility was constructed in the 1940s to decontaminate and concentrate plutonium solution from the bismuth phosphate process in B Plant. In the mid-1950s when the bismuth phosphate process was abandoned for more efficient processes, the 224-B facility became excess to programmatic needs. As a contaminated, retired facility, this building is included in the Department of Energy (DOE) Surplus Facilities Management Program (SFMP).

The 224-B Building is being maintained in a safe storage condition. Facility access is controlled, but the processing area is near ambient pressure because there is no operating cell exhaust system. The doors are constructed of wood and over the years have warped and shrunk. The plutonium inventory, deteriorating condition of the physical barrier and low differential pressure between the cells and the outside environment resulted in a high radiological factor* being attributed to this facility in RHO-WM-PL-10, Long-Range Decommissioning Plan for Rockwell Hanford Operations Facilities Management Program. The radiological factor and the value of the facility for potential reuse give this project a high priority for decommissioning with respect to the other Hanford 200 Areas SFMP facilities.

1.2 OBJECTIVES

1.2.1 Project

The objective of this decommissioning project is to reduce or eliminate the radiological hazards of 224-B and make approximately 30,000 ft^2 of the building available for beneficial reuse. Equipment and piping will be removed and the building surfaces decontaminated.

1.2.2 Document

The purpose of this project plan is to describe the decommissioning project and thereby support the allocation of resources and the preparation of schedules, detailed procedures, a safety analysis report and environmental documentation. Sections are included to describe the building, present the guiding criteria, and describe a work breakdown structure and cost estimate.

*The radiological factor is a nondimensional factor used in making relative comparisons among the Surplus Facilities Management Program facilities in the referenced document.

1.3 SCOPE

This project plan addresses the decommissioning of the 224-B Building to make it available for reuse. This includes the removal of all process equipment and piping, followed by the decontamination of building surfaces. Any connections between the building and any potential sources of contamination will be severed to isolate the building. This includes disconnection from transfer lines, waste lines, and the B Plant ventilation system. The building ventilation supply and service piping will remain to the extent that it is not contaminated.

Repairs to the building will be made only to assist in the decommissioning and to make the building safe and secure at the end of the project. Repairs will not be made to make the building useful for any specific purpose and systems will not be upgraded (such as electrical and fire protection) unless these systems are needed to safely leave the building in standby.

2.0 FACILITY INFORMATION

2.1 PHYSICAL DESCRIPTION

The 224-B Building (fig. 2-1) is constructed of reinforced concrete and concrete block. The first and second floors have approximate outside dimensions of 197 ft by 60 ft. The third floor is 145 ft 6 in. by 60 ft. The building is divided along its length by a 1-ft thick concrete wall into 2 main sections. Offices and galleries are separated from the processing cells by a dividing wall.

The first floor of the office and gallery portion of the building is 13 ft high. It contains offices, a restroom, a change room, a lunchroom and a mechanical room. The mechanical room houses the building's air treatment and supply equipment and the motor control centers for the processing equipment. In addition, there is a room at the west end of the building that was used as a loadout room. A 4-in. by 3-ft by 2-ft 8-in. high stainless steel tank enclosed in a hood is located in this area. Following deactivation of 224-B, this area of the building was converted to a regulated workshop. Part of the conversion involved isolating the loadout hood from the remainder of the room with a frame and plywood wall. In addition, a large roll-up door was installed in an outside wall of the loadout area.

The 12-ft high second floor of the gallery side of the building contains a pipe gallery (fig. 2-2) for A to E cells and an operating gallery for F cell. Aqueous makeup, steam and water piping, instrument and air tubing and electrical conduit pass through the 1-ft thick concrete wall from

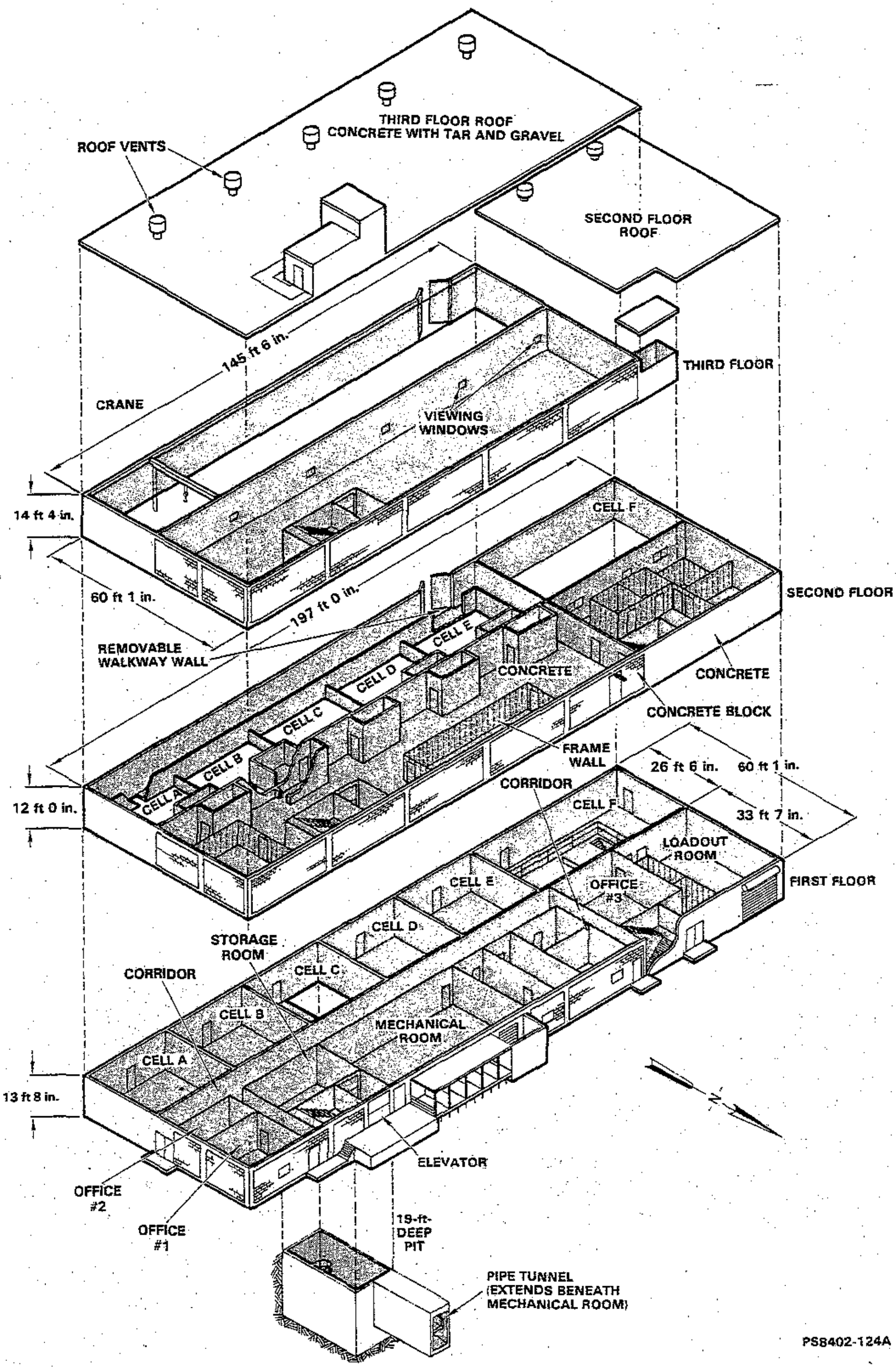

Figure 2-1. Exploded View of 224-B Building.

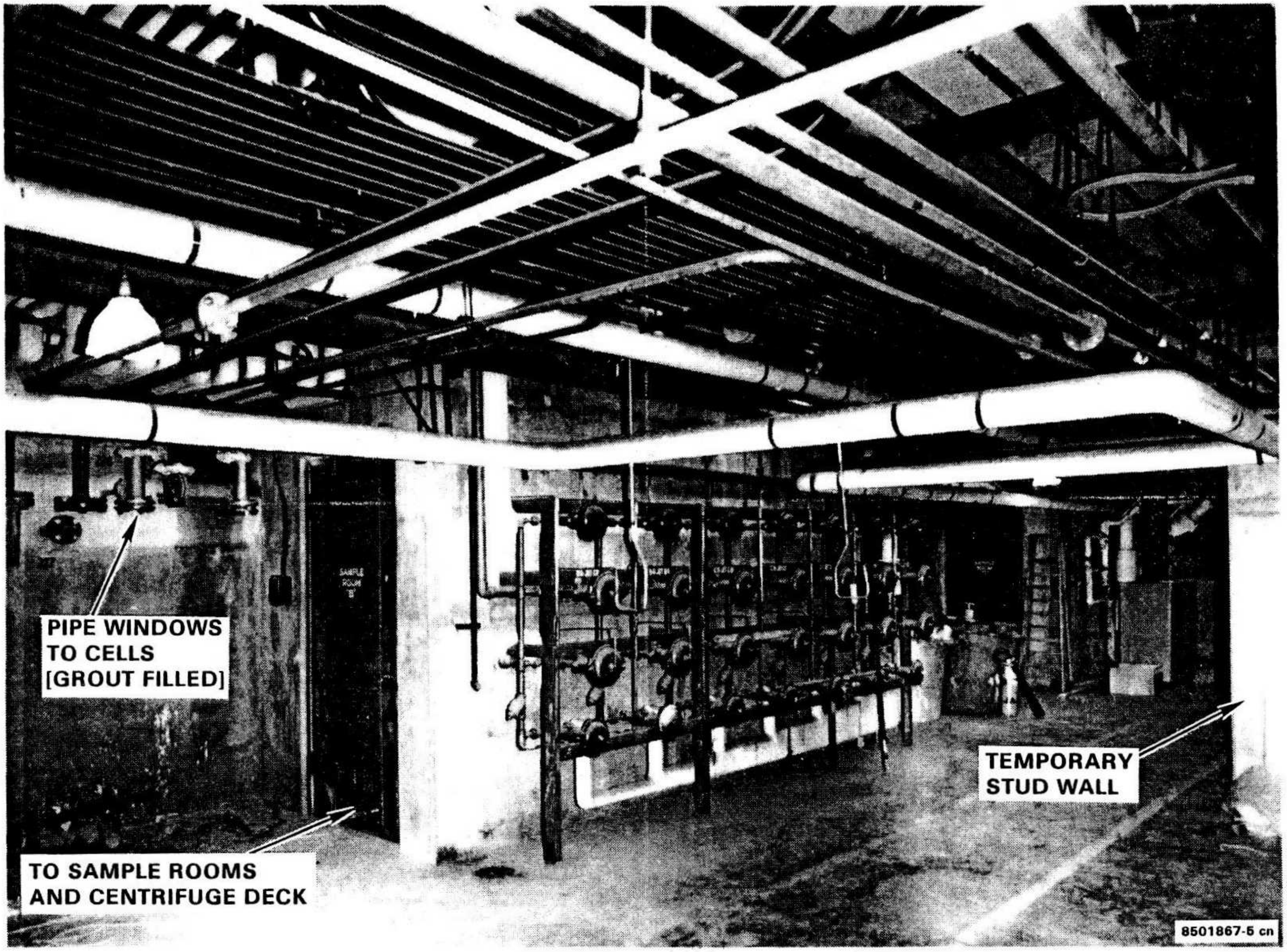

Figure 2-2. View of the 224-B Pipe Gallery (Second Floor).

the pipe gallery to A through E cells. The piping, tubing and conduit passes through windows that were left in the wall when it was poured. The windows were cemented over to seal the cells from the gallery~~,~~ following installation of the piping.

There is a sample room for each of A through E cells in the second floor pipe gallery. This room doubles as an airlock to an operating deck in A, B, D, and E cells.

The west end of the second floor gallery was the operating area for F cell. There are panelboards in this area and viewing windows into the cell. Pumps and aqueous make-up tanks for F cell that were originally installed in this operating gallery have been removed. The piping into the cell has been blanked on the gallery side of the metal partitioning wall that isolates the cell.

When the first floor loadout room was converted to a regulated shop, the second floor was modified for use as offices and lunch rooms. There are frame and drywall walls in the pipe gallery and the F cell operating gallery that define these rooms.

The third floor gallery is an operating gallery for A through E cells (fig. 2-3). There are aqueous make-up tanks, scales, pumps and control panels for the five cells. The cells can be observed through windows on this level. There are shielded covers that slide over the windows.

An elevator on the gallery side of the building serves all three floors. The 4-ton capacity elevator has a 7-ft by 8-ft high opening and provides access to the building from a concrete loading platform.

The processing portion of the building consists of six cells, A through F. Five of the cells, A to E, are three stories high (40 ft) and are separated from each other by 15-ft high, 8-in. thick concrete walls (fig. 2-4). Each of these cells is approximately 25 ft by 28 ft. Cells A, B, D and E are similar in equipment and configuration. On the first floor of each cell there are two 9-ft dia by 9-ft tall tanks and one 4-ft, 6-in. dia by 7-ft tall tank. (B cell has an additional tank with the smaller dimensions.) Some of the tanks are equipped with agitators and motors (see appendix A). A, B, D and E cells also have a 10-ft by 12-ft operating deck at the second floor level. Access to the decks is through the sample rooms in the second floor pipe gallery. A 40-in. centrifuge was located on each of these operating decks. After the building was deactivated, the E cell centrifuge was removed from the operating deck and placed on the cell floor. A temporary plank and plywood deck has been built over E cell at 5 ft above the second floor level.

C cell differs from the other cells in structure and arrangement. Approximately half of the cell is a deep cell; the floor is 19 ft below the first floor level (fig. 2-5). Vessels in the deep cell include two 4-ft 6-in. dia by 7-ft high tanks and one 9-ft dia by 9-ft high tank. A 5-ft 6-in. by 11-ft high pipe tunnel extends 34 ft from the deep cell

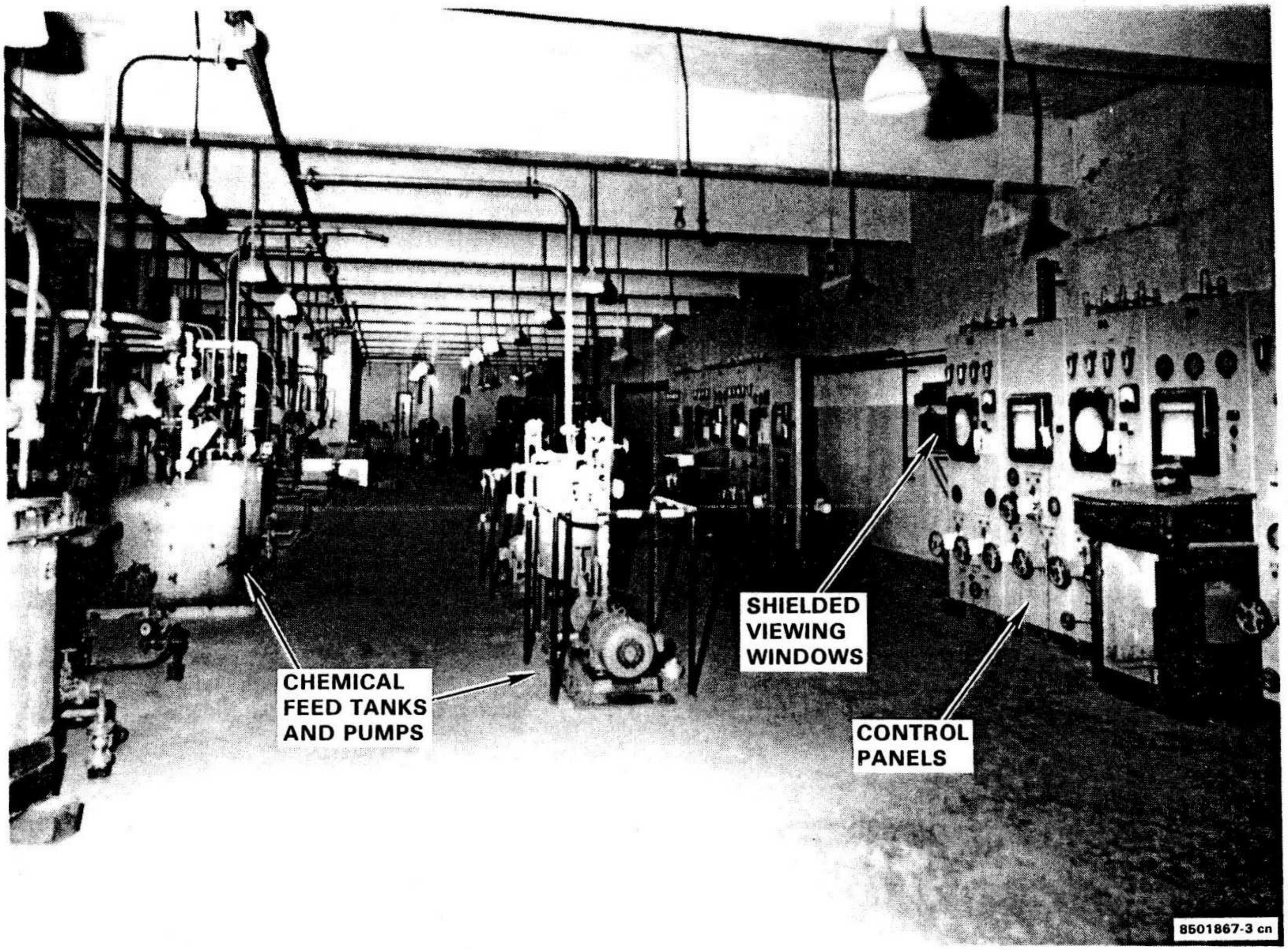

Figure 2-3. Operating Gallery for A through E Cells. (Third Floor).

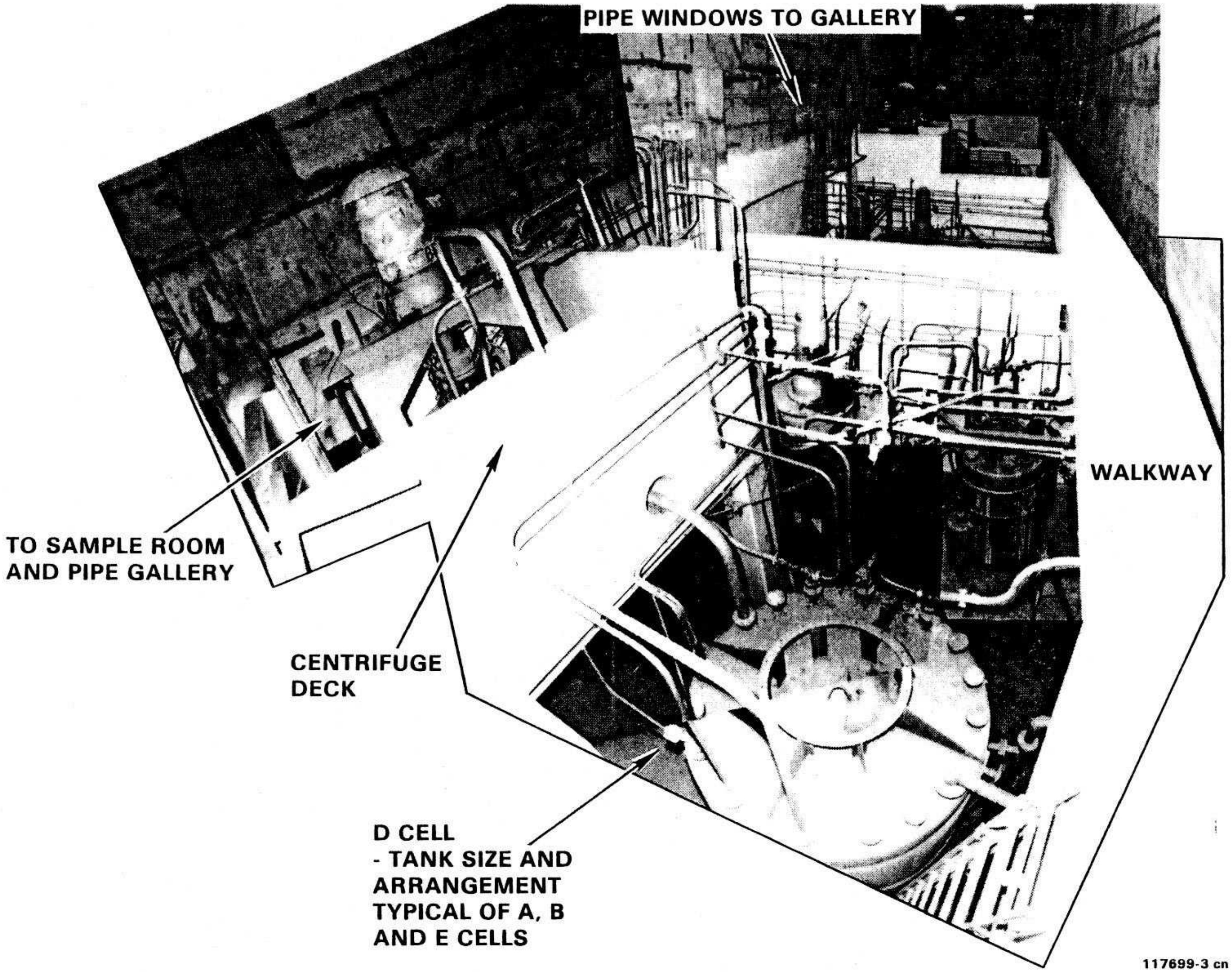

Figure 2-4. Operating Gallery for A, B, C, and D Cells.

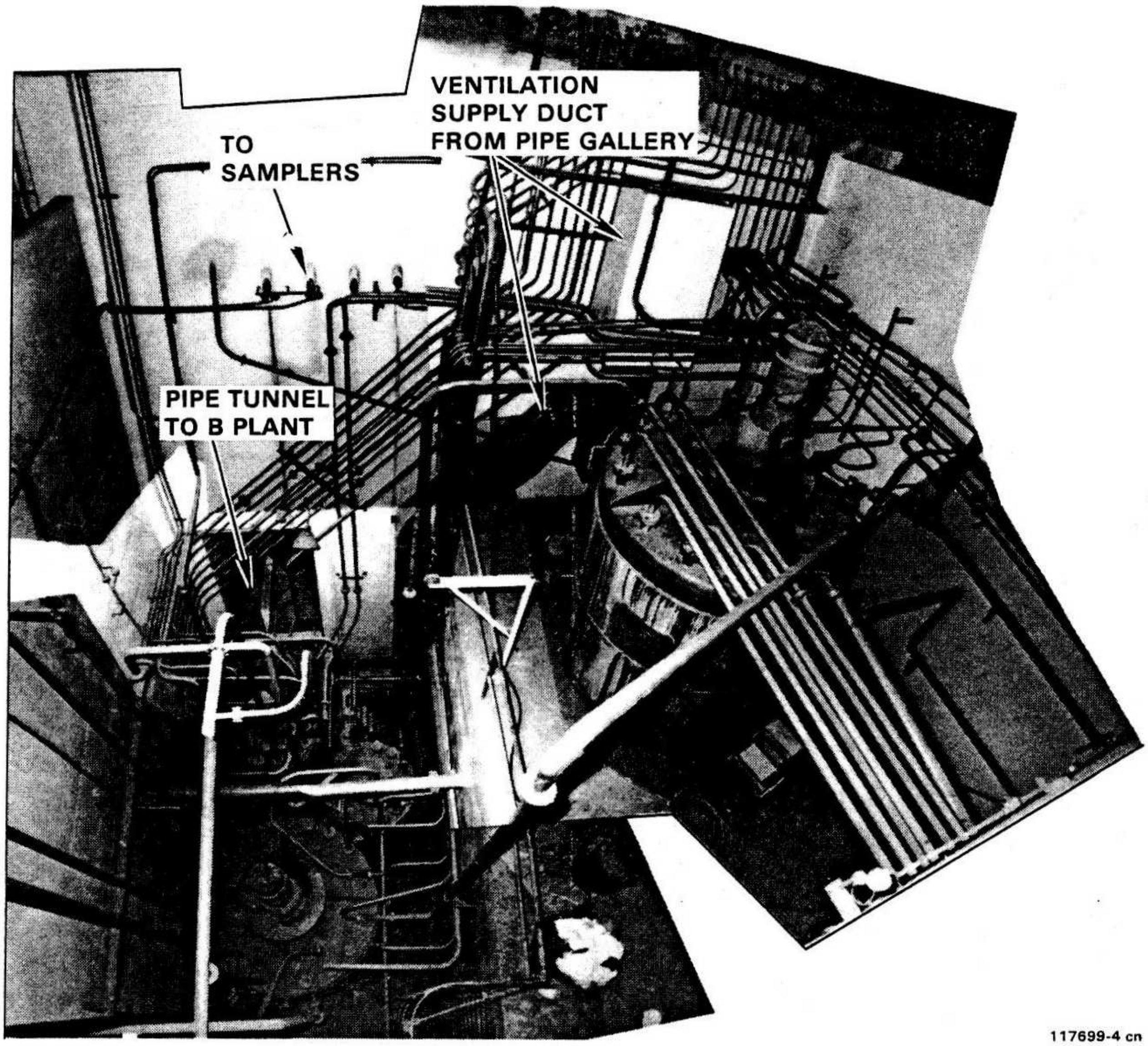

Figure 2-5. Photo Mosaic of Cell; C-7 Tank will Collect Cell Drainage (bottom left of picture).

beneath the first floor offices to a pipe encasement. The piping in this tunnel and the encasement were used for transferring solutions between 221-B (the separations facility) and 224-B (the concentration facility). A single 9-ft dia by 9-ft high tank sits on the first floor level of C cell.

In addition to the access to the A, B, D and E operating decks, there is a ground-level personnel access door into each of the five cells from outside. Additionally, a 12-ft by 21-ft high equipment access door is located in the top portion of the outside wall of E cell.

A manually operated, 8-ton bridge crane is installed over the cells. The rails run the length of A to E cells allowing access to each of them. The bridge can be aligned with a rail that passes through the equipment access door allowing the crane to move equipment into and out of the building. The crane is operated from a walkway that extends around the outsides of the cells at the second floor level (refer to fig. 2-1). A 6-ft high wall shields the walkway from the cells. There are access doors to the walkway at both ends of the A to E cell pipe gallery.

The 50-ft, 6-in. by 25-ft by 24-ft high F cell (fig. 2-6) is separated from the other cells by a concrete wall; only process and waste piping connect F cell with the others. One quarter of F cell is a 12-ft, 8-in. by 25 ft centrifuge deck that is elevated 7 ft above the remainder of the cell floor. F cell can be entered through doors from the loadout area, the outside and from the second floor operating gallery.

There are two 26-in. centrifuges on the elevated operating deck. On the first floor level are four vessels with dimensions of 4-ft dia by 5-ft tall. Additional equipment includes a small centrifuge (approximately 12 in. dia) and two small vessels (approximately 1-ft 6-in. by 2-ft tall). A scale and agitator motor have been placed in F cell for storage.

2.1.1 Service and Drain Piping

The service piping and aqueous make-up piping entered the building at the east end. The aqueous make-up chemicals (originating from 271-B), the steam piping and pressurized air all entered the building through overhead lines. Subsequent modifications have removed the aqueous chemical piping and rerouted the steam and air piping underground. Sanitary and raw water also enter the building below grade at the east end of the 224-B Building (see fig. 2-7).

There are four sewer systems that were used in 224-B. In addition, there is an internal cell drainage system that collected drainage in a waste receiver tank in the deep portion of C cell (fig. 2-8).

A gutter along the east side of each of the A to E cells drains to a 6-in. clay pipe laid below the cell floors. There is also a floor drain in

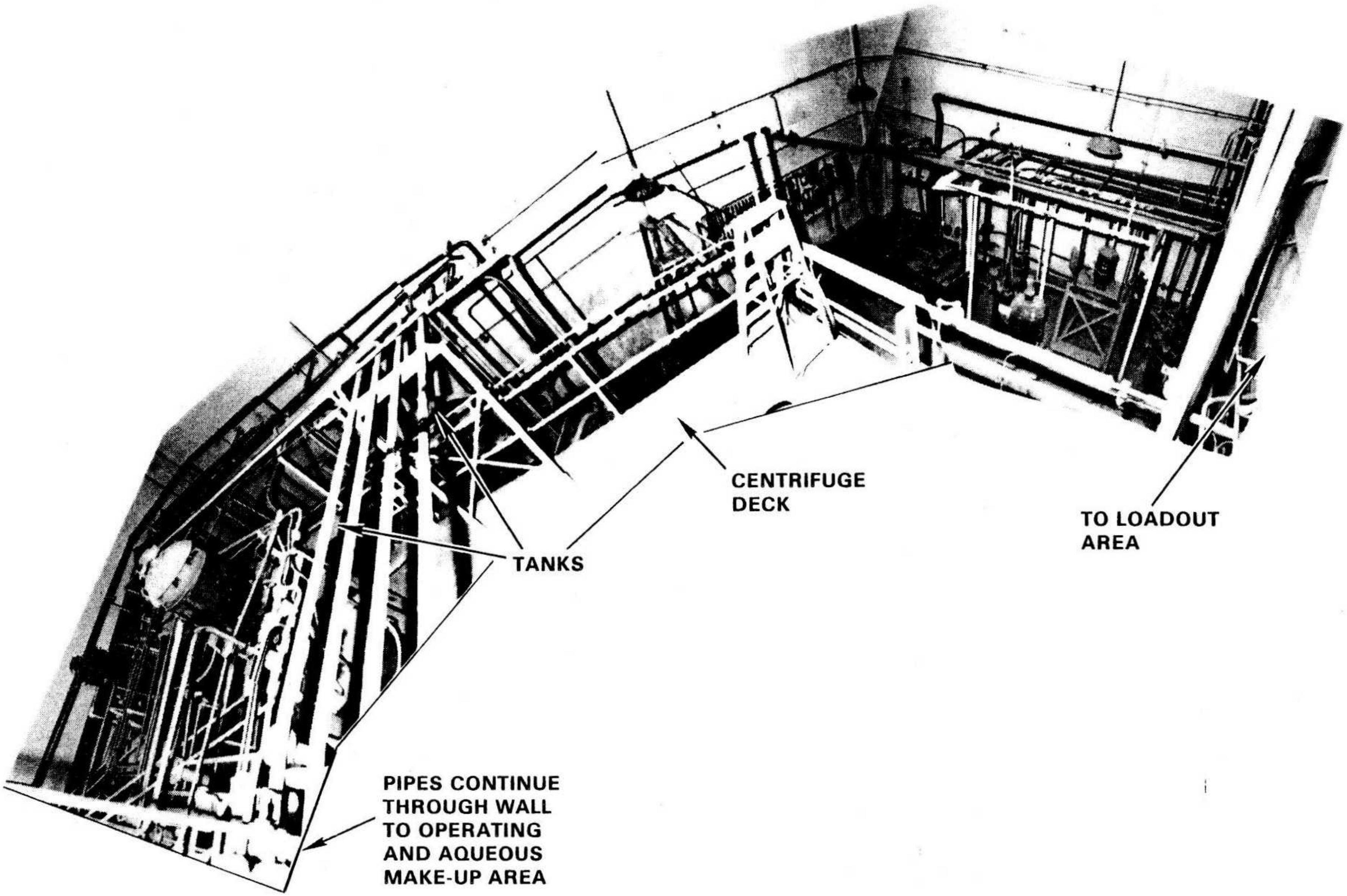

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Figure 2-6. Photo Mosaic of F Cell (process tanks at left side of picture are obscured by piping).

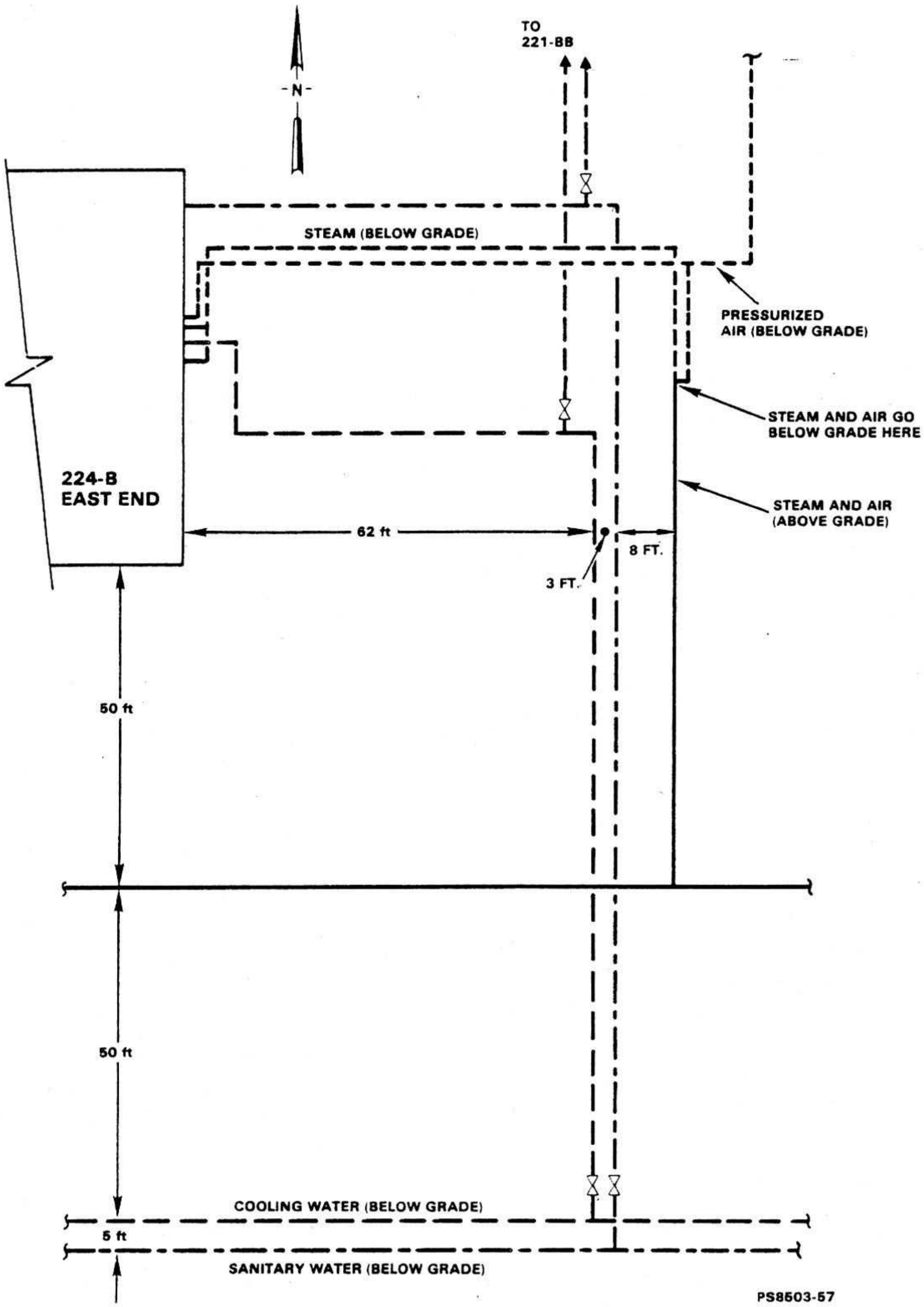

Figure 2-7. Service Piping to 224-B.

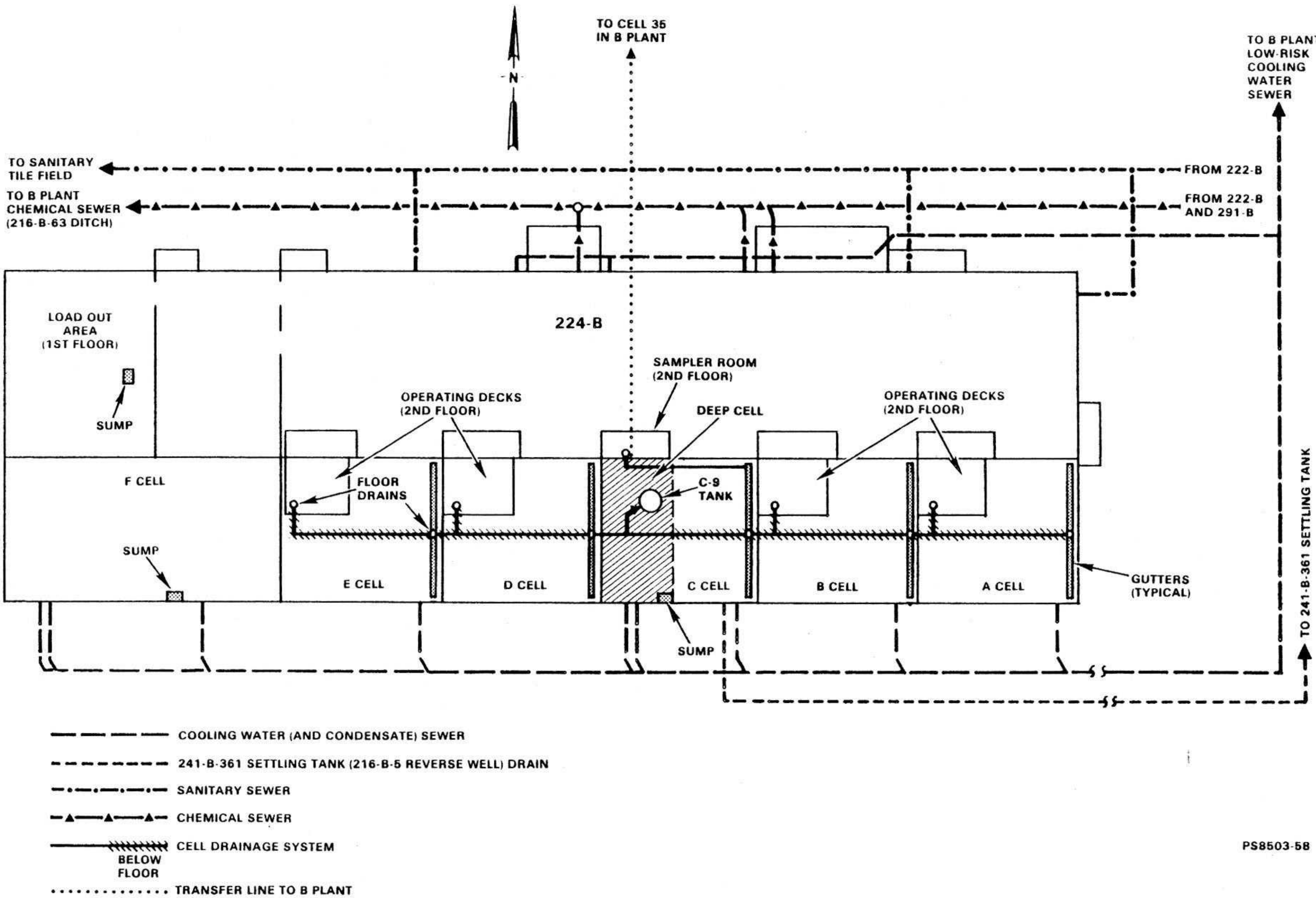

Figure 2-8. 224-B Drain and Sewer Systems.

the corner of the A, B, D and E cell operating decks that drains to the 6-in. line. The 6-in. drain line is sloped from each end of the cells toward C cell.

In C cell, the drain line empties into the C-9 tank (originally it drained to the larger C-7 tank). Drainage from the deep portion of C cell collects in a sump where it can be jetted to C-7 tank. F cell and the loadout room each drain to a sump. The sumps can be emptied by jetting the waste through a series of tanks until it is collected in C-8 tank.

The C-8 tank contents could be jetted to the 216-B-5 reverse well through the 241-B-361 settling tank (241-B-361 settling tank is an SFMP facility, which is to be addressed by another project). This routing is now out of service (fig. 2-8).

A cooling water drain line exits each of the cells. The drain lines connect to a header laid parallel to the south wall of 224-B. Past the east end of the plant, the pipeline turns north and runs to B Plant where it connects to the 24-in. low-risk cooling water sewer.

The building sanitary sewer (toilets, sinks and showers) drains to a pipeline that is routed around the west end of B Plant to a sanitary tile field on the north side of B Plant. The pipeline also serves a building to the north and a building to the east of 224-B (fig. 2-8).

Floor drains on the first, second and third floors of the office and gallery portion of the building drain to a pipeline on the north side of the building. This pipeline also receives waste from the 291-B stack area and is connected to drains in the nearby 222-B building. This drain line is also routed around the west end of B Plant and continues on to flow into the B Plant chemical sewer (fig. 2-8).

An additional pipeline shown in figure 2-8 is a transfer line that is still intact to cell 35 of B Plant. Since there are no direct connections from 224-B to tank farms, this line could be used for waste routing. Its usage will depend upon a successful hydrostatic test of the line, the radionuclide content of the waste, and whether the transfer will interrupt B Plant operations.

2.1.2 Air Balance

The air balance in 224-B was achieved using a combination of air supply and building exhaust. Air was supplied through ducting to the first and third floors of the office and gallery side of the building. The supply air flowed from these floors to the second floor where fans blew air into each of the five cells. Ducting also routed air to the F operating gallery and the loadout room. Air leaked from these two areas into the F cell. Cell exhaust was provided by roof ventilators. There was one 3,700 ft^3/min ventilator over each of A through E cells, and two 6,000 to 8,000 ft^3/min ventilators for F cell. The roof ventilators were not filtered and are no longer running.

The air balance provided now is from the building supply only; there is no active cell exhaust system and the fans drawing air from the pipe gallery to the cells are turned off. Table 2-1 shows the differential pressures measured between the cells and the galleries and between the cells and the outside in February 1985.

Table 2-1. 224-B Ventilation Differential Pressures.

Pressure in	With respect to	In inches of water (gauge)
A to E cells	Galleries	-0.3
A to E cells	Outside	-0.025
F cell	Galleries	-0.22
F cell	Outside	0

Vessel ventilation for 224-B tanks and centrifuges is provided by the B Plant main exhaust system (the vacuum is created by the 291-B fans). Stainless steel subheaders that are connected to the tanks and centrifuges exit the building above grade, but immediately connect to 6-in. dia, below grade, clay pipes. The clay pipes connect to the 24-in. dia clay header laid along the south and west sides of 224-B (fig. 2-9). The 24-in. line connects to the B Plant main exhaust tunnel at the east end of 221-B (B Plant). In areas where the original cover was less than 4 ft or greater than 7 ft deep, the clay pipe is protected by a reinforced concrete encasement.

The 224-T building is constructed the same as 224-B and was used for similar purposes during the 1940s and 1950s. During a facility modification, the 24-in. clay pipe along F cell (at 224-T) was excavated, revealing plutonium-contaminated soil. Apparently, moisture condensed in the tunnel, seeped through the joints, and carried plutonium contamination with it. An area 50-ft long by 12-ft wide by 12-ft deep was excavated, yielding 139 drums of soil contaminated with approximately 72 g of plutonium. It is quite possible that a similar condition exists at 224-B.

2.2 HISTORY

The 224-B Plutonium Concentration Facility was constructed in 1944 to concentrate and decontaminate plutonium that was separated by the bismuth phosphate process at 221-B (B Plant).

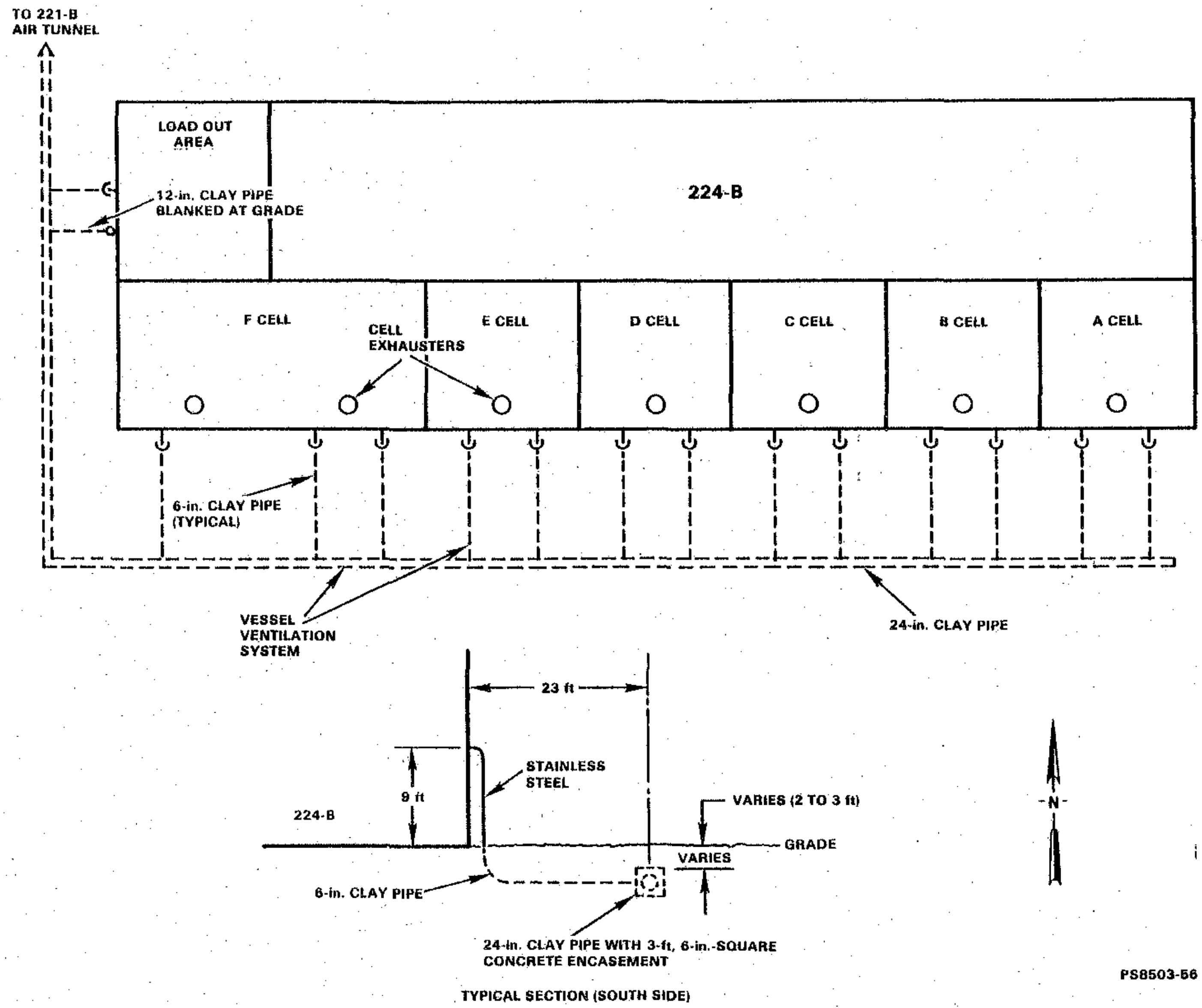

Figure 2-9. 224-B Vessel Vent System Outside Lines.

Originally, five of the six cells were used in the process; B cell was available as a back-up for processes in D and E cells.

Later, changes in processing in 221-B resulted in a greater output rate that necessitated an increase in the capacity at 224-B. In 1948, B cell was activated to operate in parallel with E cell. Also in 1948, previously unused B-4 tank was activated to operate in conjunction with F cell operations. Additional modifications to the process were made in 1950 by repiping within D cell and activating the second centrifuge in F cell.

The B Plant bismuth phosphate process was terminated in 1952 and deactivation of 224-B followed shortly. In 1954, B Plant and 224-B were modified and prepared for reactivation as contingency for the plutonium-uranium extraction (PUREX) process failing. The success of the PUREX process ended the modifications, prior to completion of the entire project. Some of the changes that were made included the replacement of some of the cell tanks and the installation of a 4-ft 6-in. by 7-ft tall waste receiver tank (C-9) in C cell.

In 1968, the on-site construction contractor occupied and modified part of the office and gallery side of 224-B. The aqueous makeup and scale tanks from the F operating area were removed and frame and sheetrock walls were constructed on the second floor to make offices and lunchrooms.

The loadout room was converted for use as a regulated workshop. Framing and plywood were erected to isolate the F-10 hood from the room and to separate the loadout room from its normal outside entrance. A new cargo-sized doorway was cut through the north side of the building and covered with a steel rollup door. The construction contractor moved from the offices and the shop area in the early 1980s.

During the last couple of years, portions of the building have been used for storage and as a temporary office and lunchroom for a crew of steamfitters.

2.3 RADIOLOGICAL CHARACTERIZATION

A radiological characterization of 224-B was conducted in FY 1985 to support the decommissioning planning (Gould and Troyer 1985). The purpose of the characterization was to determine the radiological conditions that will be encountered during the D&D project, and to establish a radiological inventory for the facility. A summary of the dose and exposure rates is presented in table 2-2. Estimated inventories for the facility are shown in table 2-3. More detailed radiological data are reported in appendix B.

Table 2-2. Summary of 224-B Exposure/Dose Rates.

Cell	Cutie pie window open (mrad/h)	Snoopy (mrem/h)	Reuter-stokes ion chamber (μR/h)[a]
A	<1	<0.1	10.2 to 11.5
B	<1	<0.3	10.0 to 13.3
C (grade)	<1	<0.1	up to 20
C (pit)	3[b]	<0.1	<50 to 60
D	<1	<0.1	15 to 18
E	<1	<0.1	up to 12.9
F	<1	<0.1	18 to 24

[a]The background reading outside the building was ~10 μR/h.

[b]Piping in the tunnel has a dose rate of up to 20 mrad/h on contact.

Table 2-3. Summary of 224-B Radiological Inventories.

	Isotopic inventory (in Ci except as noted)				
Cell	^{241}Am	^{239}Pu	^{137}Cs	^{90}Sr	^{60}Co
A	5.9 E-02	7.7 E-01	1.6 E-02	3.6 E-02	6.0 E-03
B	8.8 E-02	1.2 E+00	8.2 E-03	6.0 E-03	3.0 E-03
C	2.0 E-01	2.6 E+00	2.7 E-01	1.9 E+01	3.6 E+00
D	3.5 E+00	8.6 E+00	1.0 E-02	1.2 E-01	1.5 E-02
E	6.7 E-02	8.8 E-01	4.4 E-02	5.4 E-02	6.0 E-03
F	1.3 E+00	1.7 E+01	6.6 E-01	1.3 E+00	<5 E-03
Loadout hood	6.8 E-04	8.9 E-03	1.9 E-08	-	-
Total	5.2 E+00	3.1 E+01 (505 g)	1.0 E+00	2.1 E+01	3.6 E+00
Air tunnel[a]	6.5 E-02	3.6 E+00 (58 g)	1.6 E-03	-	-

[a]The inventory reported for the air tunnel is only for the approximately 190-ft portion that will be removed in this project. This portion lies parallel to the south wall of 224-B.

The radiological characterization determined the following items:

- The heavy coating of dust and the pigeon feces found in some of the cells are contaminated with americium as well as fission products
- The highest concentrations in cell dust, for all radionuclides except ^{60}Co, were found in F cell
- The deep portion (pit) of C cell had the highest levels of ^{60}Co. The walls of the pit have water marks, indicative of past flooding. Concrete chipped from the wall is contaminated
- Many of the flanges were significantly more contaminated than other exterior surfaces surveyed
- Each tank was viewed through a riser to determine its contents. With few exceptions, the tanks were empty. The C-9 tank had a dry, white crystalline substance approximately 4 to 6 in. deep on the bottom. A sample of this substance was surveyed with field instruments and found to be low activity ($\sim$1,500 d/m alpha, 600 cpm B-G). The E-4 tank has a small pool of oil covering about half of the tank bottom; the oil showed only background radiation levels. The F cell tanks each had a thin film that appeared to be dust or a layer remaining after liquid had evaporated
- The gutters and sumps along the east walls of A through E cells and along the south wall of F cell had the highest radiation reading of the cell floor areas.

3.0 CRITERIA

This section presents criteria for worker radiological protection, waste handling, and facility condition at the end of the decontamination and decommissioning (D&D) project.

3.1 RADIOLOGICAL PROTECTION

The following criteria shall be met during the decontamination of 224-B:

- Worker doses shall be maintained as low as reasonably achievable (ALARA) and within the Rockwell Hanford Operations guidelines (table 3-1) set forth in RHO-MA-220, REV 1, Radiological Standards and Operational Controls.

- Radioactive contamination shall be controlled to keep exposure to the general public to the lowest practical levels not to exceed the limits of DOE Order 5480.1A, Chapter XI.

- Worker radiological safety shall be protected by the use of administrative and physical controls and by performing work in accordance with the General Regulations and Practices for Radiation Work.

Table 3-1. Rockwell Hanford Operations Occupational Dose Guidelines.

Type of exposure	Annual	Quarter	Week
Whole body, head and trunk, gonads, lens of eye, red bone marrow, blood-forming organs	3	1.25	.3
Skin (except hands and forearms)	9	3	.9[a]
Other organs (except bone)	7.5	--	--
Bone	15	--	--
Forearms	15	5	--
Feet	15	5	1.5[b]
Hands	15	5	1.5[c]

Note: All measurements are in rem.

[a]As measured by the "unfiltered" chip in the record thermoluminescent dosimeter (TLD), and "unfiltered" supplementary TLD, or timekeeping with an open window Cutie Pie (CP).

[b]As measured by a closed window CP and timekeeping or a supplemental TLD dosimeter.

[c]As measured by a finger ring worn with the TLD chip directed toward the source, or an open window CP and timekeeping (RHO-MA-220, REV 1, Radiological Standards and Operational Controls).

3.2 WASTE HANDLING

Waste packaging, shipping and disposal shall be in conformance with the following criteria.

- Waste shall be segregated for disposal according to contamination type and level.

- Solid waste packaging, shipping and disposal shall be in accordance with RHO-MA-201, Hazardous Material Packaging, Shipping and Transportation Manual, and RHO-MA-222, REV 1, Hanford Radioactive Solid Waste Packaging, Storage and Disposal Requirements.

- Transuranic (TRU) waste must be certified to meet Waste Isolation Pilot Plant (WIPP) waste acceptance criteria as detailed in HS-BS-0012, Packaging Transuranic Waste for Shipment to the Waste Isolation Pilot Plant.

3.3 RESIDUAL RADIOLOGICAL LIMITS

At the end of the decommissioning project, the building will meet the following radiological conditions.

- There shall be no smearable contamination; a low level of fixed contamination is permitted.

- The whole body dose rate to the maximally exposed individual shall be less than 1 mrem/h.

- The average annual dose from residual contamination to any individual shall be less than 0.5 rem/yr to the whole body, gonads or bone marrow, and less than 1.5 rem/yr to any other organs.

3.4 PHYSICAL CONDITION

At the end of the decommissioning project, the building must meet the following criteria with respect to its physical condition and configuration.

- Any openings through floors shall be made safe from falling and tripping hazards.

- The building shall be secure from intrusion by animals and the elements and unwarranted intrusion by man.

- Any openings created through walls shall be closed in a permanent manner.

- Electrical wiring and service piping left in the building shall be terminated in a manner to allow the services to be safely returned to service.

- The building shall be isolated or sealed from any systems which have the potential of contaminating the building.

- Services required for routine personnel entry or to protect the facility from the weather shall be left intact and functioning.

- Any residual contamination will, at a minimum, be painted with a yellow coat of paint covered by a contrasting color of paint. The yellow paint will serve as an indication for future-users of the possible presence of contamination.

4.0 DECOMMISSIONING PLAN

4.1 GENERAL

4.1.1 Decommissioning Approach

The decommissioning of 224-B will follow the sequence of gathering data, planning, implementation and closeout. Initial efforts include the gathering of facility and radiological information and preparing safety and environmental documentation. Once the planning is developed, the building and crew will be prepared for the ensuing decommissioning. The D&D workers, with the support of other crafts, will remove the contaminated piping and equipment for reuse or disposal. Since the building is to remain, electricity and service piping such as steam, water and pressurized air will be left in the gallery/office portion of the building. Following equipment removal, the D&D workers will decontaminate the building surfaces. To complete the building decommissioning, the building will be refurbished to make it safe for occasional personnel entry. A more detailed discussion of the decommissioning steps is presented in section 4.2.

Planning and coordination of the daily activities is accomplished by a team at a weekly meeting. The team consists of representatives of the Program Office, Engineering, Radiological Engineering, Safety, D&D Operations and Production Control. Additional functional groups are included in the meeting as necessary. Any special problems that cannot be resolved at a team meeting are addressed in a work plan prepared by Engineering.

4.1.2 Decommissioning Constraints

The decommissioning will be performed in the sequence discussed in 4.1.1 and presented graphically in the logic flow diagram (fig. 4-1). Since the building has been out of service for many years and no other facilities are included in this project, most of the constraints on the decommissioning sequence are internal to the building.

The following list enumerates configuration or sequential constraints that affect the decommissioning logic for 224-B.

- Utilities must be isolated from the work area before any dismantling work begins. This is necessary for worker safety. All utilities that are left in an energized condition must be clearly marked with signs.

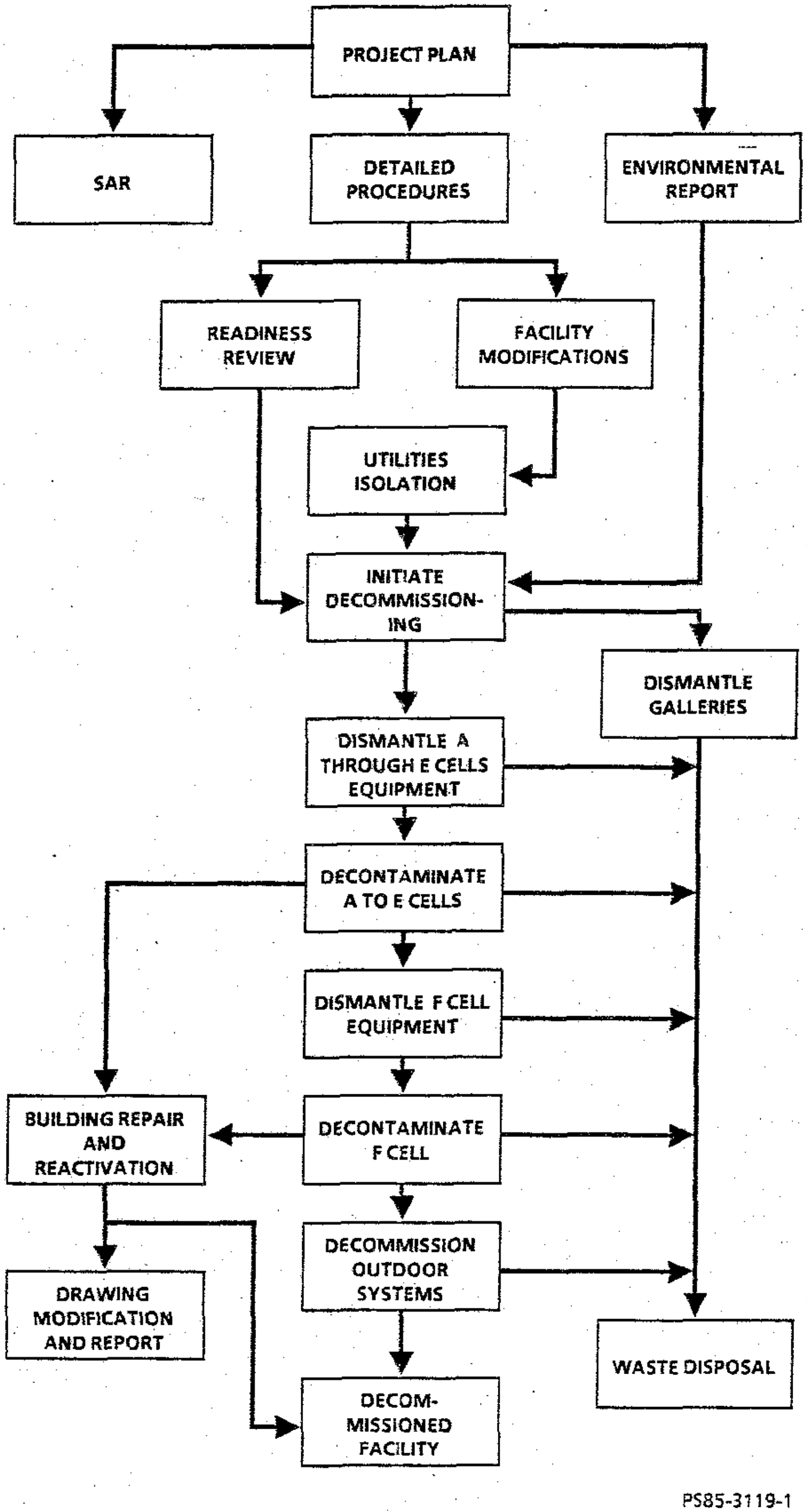

Figure 4-1. 224-B Decommissioning Logic Flow Diagram.

- o Air locks (greenhouses) and high efficiency particulate air (HEPA) filtered exhaust ventilation must be provided for the cells prior to significant work in the cells. These are needed to ensure that no environmental releases of radioactivity occur.

- o The A through E cell work must be essentially complete prior to starting work in F cell. This constraint is caused by the necessity to ventilate the cells and the limited number of portable exhausters available. Conversely, F cell could be completed before the A through E cells.

- o Piping should be removed from the second floor gallery prior to dismantling the third floor gallery. This allows better access and clearances for removing through-the-floor scales and tanks that are mainly on the third floor.

- o The C-7 tank will be the last tank removed from the A through E cells. This tank should be left in place and connected to the cell floor drainage system. If there is a need to wash cells or tanks, the water can be collected in this tank.

4.1.3 Material Accounting

Equipment and nuclear material (Six 1983) removed from the facility during this project will be reported to the appropriate accounting organization. The equipment listed in appendix A will be reported by D&D Operations to the Property Management Department on either a Property Disposal Request or a Property Transfer depending upon the disposition. The residual nuclear materials that are disposed of with equipment, or cleaned from the facility surfaces, will be recorded on waste disposal forms. This information will also be reported to the Nuclear Materials Control Department for accountability purposes.

4.2 TECHNICAL PLAN

The following sections describe the work involved in each of the work breakdown structure elements shown in the work breakdown structure in fig. 4-2. More detailed work breakdown structures are shown for each of the work breakdown structure elements in the corresponding sections.

4.2.1 Project Planning

The project planning work package includes the front-end review and analysis of the facility, the method for decommissioning and the impacts of the decommissioning. The work breakdown structure for this work package is depicted in fig. 4-3 and discussed in 4.2.1.1 through 4.2.1.4.

224-B DECOMMISSIONING PROJECT

- 1.0 PROJECT PLANNING AND CONTROL
- 2.0 MOBILIZATION AND BUILDING PREPARATION
- 3.0 GALLERY DISMANTLING
- 4.0 A THROUGH E CELLS DISMANTLING AND DECONTAMINATION
- 5.0 F CELL DISMANTLING AND DECONTAMINATION
- 6.0 YARD PIPING DECOMMISSIONING
- 7.0 PROJECT CLOSEOUT

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Figure 4-2. 224-B Decommissioning Project Work Breakdown Structure.

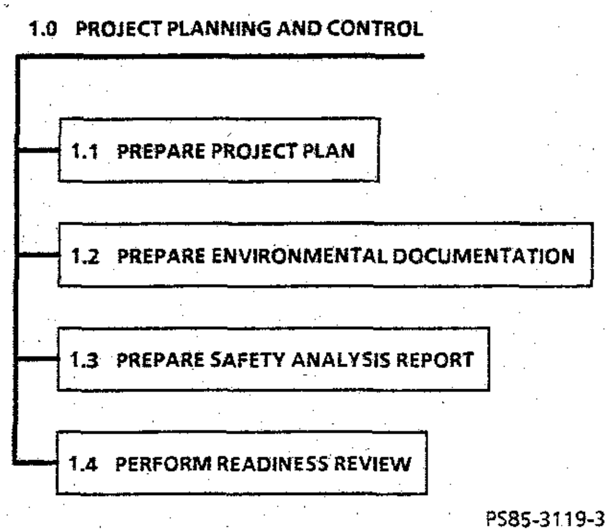

Figure 4-3. Project Planning Work Breakdown Structure.

4.2.1.1 Prepare Project Plan. This task involves the review of the facility and its equipment, collection of radiological data, and presentation of a plan for completing the decommissioning project. This project plan is the result of this effort.

4.2.1.2 Prepare Environmental Documentation. Environmental documentation, in the form of an action description memorandum (ADM) and environmental evaluation, will be prepared in compliance with the National Environmental Policy Act (NEPA). It is anticipated that no further environmental documentation will be required to complete this project.

4.2.1.3 Prepare Safety Analysis Report. The project, as described in the project plan, will be reviewed with respect to the possibility and consequences of accidents. The resulting report may identify areas requiring physical or administrative controls to reduce the possibility or consequences of an accident.

4.2.1.4 Perform Readiness Review. The readiness review is an appraisal of the thoroughness of preparation for the D&D project. The review board, comprised of senior personnel familiar with safety and environmental requirements, examine the documentation to be used, equipment available, and qualifications of the personnel performing the work. Recommendation to commence work is made when the readiness review action items have been completed and approved.

4.2.2 Mobilization and Building Preparation

This work package includes the activities that are necessary to provide quarters for the D&D workers and to prepare the 224-B Building for the D&D work to follow. The corresponding work breakdown structure is shown in fig. 4-4.

4.2.2.1 Install Cell Ventilation System. The cell ventilation was originally supplied by fans exhausting through the cell roof directly to atmosphere. This system has been shut down while the facility is in protective storage. A HEPA-filtered exhaust system will be installed to provide a nominal -0.25 in. of water differential pressure in the cells with respect to outside.

The cell exhaust system will be designed to use the exterior doors as the exhaust air intakes. It will be possible to switch the intakes to different cells to maximize the air flow in the area where work is being performed. Since the F cell air space is separate from the A through E cell air space, the exhaust system will be designed to ventilate each of these cells at separate times. This creates the condition that all of the decontamination in one of these air spaces must be complete prior to starting in the other.

2.0 MOBILIZATION AND BUILDING PREPARATION

- **2.1 INSTALL CELL VENTILATION SYSTEM**
  - 2.1.1 DESIGN EXHAUST SYSTEM (EO)
  - 2.1.2 INSTALL EXHAUSTER (P)
  - 2.1.3 SEAL BUILDING OPENINGS
- **2.2 PROVIDE PERSONNEL NEEDS**
  - 2.2.1 CHANGE ROOMS
  - 2.2.2 SAFETY DEVICES
- **2.3 ESTABLISH AIRLOCKS ON CELLS**
  - 2.3.1 CONSTRUCT AIRLOCKS ON OUTSIDE DOORS
  - 2.3.2 CONSTRUCT E CELL ISOLATION WALL
- **2.4 HOUSEKEEPING IN CELLS**
  - 2.4.1 PICK UP/VACUUM DEBRIS
  - 2.4.2 WASH DOWN CELL (P)
- **2.5 MODIFY FACILITY**
  - 2.5.1 CONNECT DRAIN TO C-7
  - 2.5.2 CUT DOORWAYS BETWEEN CELLS
  - 2.5.3 ISOLATE OUTSIDE SYSTEMS (EO)
- **2.6 PREPARE CRANE FOR SERVICE**
  - 2.6.1 INSPECTION BY THIRD PARTY
  - 2.6.2 REPAIR AND LUBRICATE
  - 2.6.3 INSTALL SCAFFOLDING CLAMPS
- **2.7 PROVIDE D&D UTILITIES (EO)**
  - 2.7.1 *DESIGN TEMPORARY SUPPLY SYSTEMS*
  - 2.7.2 PROVIDE NEEDED UTILITIES
  - 2.7.3 ISOLATE SELECTED CIRCUITS
  - 2.7.4 ISOLATE OTHER UTILITIES

(EO) - INDICATES ACTIVITIES THAT AN ENGINEERING ORDER WILL BE REQUIRED AS A DESIGN MEDIUM.

(P) - INDICATES ACTIVITIES THAT REQUIRE PREPARATION OR REVISION OF PROCEDURES.

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Figure 4-4. Mobilization and Building Preparation Work Breakdown Structure.

In addition to providing a HEPA-filtered exhauster for ventilation control, measures will be taken to reduce the air infiltration into the cells. The air supply ducts from the pipe gallery will be covered to isolate the galleries from the cell. Viewing windows, doors and the roof openings into the cells will be sealed to the extent practical.

4.2.2.2 Provide Personnel Necessities. This task will provide the facilities and equipment that will be necessary for the D&D workers to work in the building. The D&D workers will have most of their facilities, such as showers and lunch rooms, in another location. Men's and women's change rooms will be provided in 224-B. These change rooms will have lockers, shelving for work clothes, and regulated and non-regulated laundry hampers.

Additional necessities include safety and life protection equipment. Emergency lighting, fire extinguishers and radiation area monitors will be provided in all work areas.

4.2.2.3 Establish Airlocks On Cells. In order to maintain contamination control during the work in the cells, airlocks will be provided on entrances into the cells from outdoors or from the clean side of the building. An airlock will be provided on B cell door for access to A, B, and C cells (see 4.2.2.5 for doorways between cells). The same type of airlock will be provided for D cell to service D and E cells. These airlocks will be used for personnel access and removing small items from the facility.

The large equipment doors on E cell will have to be opened for removing large burial boxes and tanks from the facility. An airlock for these doors will be provided by extending the wall that separates D and E cells to the ceiling. Large doors will be provided in this wall to permit the movement of large pieces of equipment into E cell from the other cells. In this manner, E cell will be used as an airlock. As an alternative, a free-standing greenhouse large enough to handle vessels could be installed on the inside or outside of the equipment doors.

4.2.2.4 Housekeeping in Cells. During the radiological characterization of the building, the dust and pigeon feces that have accumulated in the cells were found to be contaminated. These, in addition to oil and grease on the outsides of the tanks, will be cleaned up to reduce the potential of contamination spread during the D&D. Initial cleanup will be done using decontamination techniques and tools that include shovels, scrapers, sweeping compounds and brooms, and HEPA-filtered vacuum cleaners. In conjunction with the facility cleanup, a temporary wood deck that was constructed over E cell will be removed.

The initial cleaning may be followed by a wash down of the cells. The wash water will flow to a tank in C cell through the floor drains. The water will be transferred to tank farms through an existing line, a temporary line or in a tank truck.

4.2.2.5 Modify Facility. The building will be modified to enhance the decommissioning effort. The modifications will aid in the ventilation and contamination control as well as worker safety.

Some of the cell doors will be covered with plastic to reduce the amount of air infiltrating into the cells and thereby reduce the ventilation capacity needed. The doors that are not covered with plastic will be provided with a secondary containment to act as an airlock. Holes will be cut through the concrete walls dividing the cells (A through E) to allow personnel access to all of the cells while minimizing the number of entrances into the cells. A, B, and C cells will be serviced by one airlock and joined by doorways cut through the walls. The deep portion of C cell makes it necessary to leave D and E cells separate from the others. Most of the piping along the walls is above the 7-ft level, so the doorways will be cut with a minimum of interference. If it is necessary to remove a pipe to provide the doorway, the method described in section 4.2.4.2 will be employed.

Since E cell will be used as an airlock, the doorway cut through the concrete wall between D and E cells will be covered with plastic to control airflow. A slit in the plastic to allow workers to pass through will be provided with a resealable fastener.

The floor drains from the A to E cells drain to the C-9 tank in the deep half of C cell. The drain line will be connected to the larger capacity C-7 tank to reduce the number of times the tank needs to be drained if the floors and walls are washed. Since this tank will receive cell drainage, it will be the last one removed from the cells. A method for monitoring the liquid level will be included.

The vessel ventilation system and the cooling water drain line will be isolated from the active systems they are connected to at B Plant. Crafts personnel will blank the vessel vent tunnel near the southwest corner of 224-B and the cooling water drain line near the southeast corner. Following the isolation, the remainder of the work on these systems can be performed by D&D workers.

4.2.2.6 Prepare Crane for Services. A bridge crane, which is mounted along the length of the A through E cells, and smaller monorail cranes will be used for removing tanks, burial boxes, etc. during the dismantling phase. The cranes will be subjected to a third party inspection prior to use in this project. Following inspection and load testing, the cranes will be repaired to correct the identified deficiencies and lubricated.

In addition to other work using the crane, some I-beam rollers may be attached to the crane or rails to allow the attachment of suspended scaffolding which can be easily moved from cell to cell. The cranes and rails will also be load tested.

4.2.2.7 Provide D&D Utilities. Temporary utilities will be provided to parts of the 224-B Building. For safety reasons, most of the electricity, water, steam and pressurized air will be isolated from the building. Where it can be done with a high degree of safety, some circuits will remain on.

The steam will be shut off except for a line to feed the ventilation supply equipment.

As a minimum, water will also be provided to the ventilation supply system.

Electrical circuits in the building will be isolated by an electrician. The systems that will remain energized are lighting and power to the ventilation supply and exhaust systems. Any services (e.g., steam, water, electricity) that are left in an active state will be prominently identified and posted prior to work by D&D workers.

The pressurized air will be blanked at the building service entrance.

4.2.3 Gallery Dismantling

This work package (fig. 4-5) includes the activities for dismantling the pipe and operating galleries of 224-B. This piping and equipment did not handle process solutions or wastes as a routine, but realistically, there is a potential that through process upsets or errors some of this piping is contaminated. Recognizing this, radiological controls will be employed during these tasks. This includes the use of containments around piping when it is initially broken.

4.2.3.1 Remove Stud Walls. The stud and sheetrock walls that were installed as temporary structures will be removed from the pipe gallery. The electrical circuits to this portion of the facility will have been deenergized, but an electrician will check the circuits and isolate the electrical wiring. The D&D workers will then remove the wall using various tools such as hammers, prybars, and saws. The waste resulting from this work will be disposed of as clean waste at the central landfill.

4.2.3.2 Remove Miscellaneous Equipment/Debris. This activity includes the removal of equipment and materials that have been stored in the gallery areas. These items will be radiologically surveyed and visually inspected to determine if any unique handling requirements exist. The materials will be packaged and removed from the pipe gallery, operating gallery and sample rooms to low-level waste burial grounds.

4.2.3.3 Dismantle Piping/Conduit/Tubing. The past usage of the piping, conduit, and tubing on the second and third floors will be determined by matching the line numbers at the cell wall penetration to the pipeline identification drawing. These lines will be marked to identify them for removal. A pipefitter will isolate lines from headers that will remain after the facility is decontaminated. Because there is a potential for

3.0 GALLERY DISMANTLING

- 3.1 REMOVE STUD WALLS
- 3.2 REMOVE MISCELLANEOUS EQUIPMENT/DEBRIS
  - 3.2.1 PIPE GALLERY
  - 3.2.2 OPERATING GALLERY
  - 3.2.3 SAMPLE ROOMS
- 3.3 DISMANTLE AND DISPOSE OF PIPING/CONDUIT/TUBING (EO)
  - 3.3.1 SURVEY/IDENTIFY PIPING
  - 3.3.2 THIRD FLOOR PIPING, ETC.
  - 3.3.3 SECOND FLOOR PIPING, ETC.
- 3.4 REMOVE REMAINING EQUIPMENT
  - 3.4.1 DESIGN AND CONSTRUCT FLOOR OPENING COVERS
  - 3.4.2 REMOVE PANELBOARDS
  - 3.4.3 REMOVE TANKS/PUMPS
  - 3.4.4 REMOVE SCALES/FRAMES
  - 3.4.5 COVER FLOOR OPENINGS

(EO) - INDICATES ACTIVITIES THAT REQUIRE AN ENGINEERING ORDER AS A DESIGN MEDIUM.

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Figure 4-5. Gallery Dismantling Work Breakdown Structure.

contamination, radiological controls will be exercised to ensure there are no releases or personnel contaminations. All lines, whether removed by crafts or D&D workers, will be drilled and swabbed to determine if any liquids are present and to ascertain the level of internal radiological contamination.

If liquids are found in a pipeline, the liquids will be collected in a controlled manner. Small volumes are absorbed in rags in waste containers; larger volumes will be funneled into containers with the appropriate disposal directed by Engineering.

Piping with internal contamination will be cut using a method that minimizes the potential for loss of contamination control. These methods include injecting the pipe with foam in the area to be cut, building a greenhouse around a group of pipes to be cut, or putting an individual plastic glovebox around the cut area of individual pipes. Asbestos lagging around the pipes will be removed using an approved method as described in section 6.0, and removed as hazardous waste.

4.2.3.4 Remove Remaining Equipment. The equipment remaining in the building galleries will be removed after all the piping connections are severed. This includes chemical feed tanks, scales, pumps and panelboards.

There are openings in the third floor where the scale tanks and tubing from panelboards pass through. Covers will be constructed for these openings to prevent a falling hazard when the equipment is removed.

The tanks, scales and pumps will be inspected and surveyed to verify that they are empty and radiologically clean. Some of these will require hoisting to raise or lower them through the floor. These will be disposed of as waste in the low-level waste burial grounds.

The panelboards will be divided into sections and removed on dollies. There are oil-filled air cleaners on each of the panelboards. The reservoirs will be removed and the oil collected in a container. This oil will be tested for the presence of polychlorinated biphenyls (PCB) and radioactivity. The ultimate disposal or storage is dependent on the outcome of these tests.

4.2.4 A Through E Cells Dismantling and Decontamination

This work breakdown structure element (fig. 4-6) will result in the removal of essentially all of the equipment, piping, tubing and conduit, and most of the radioactivity in A through E cells.

4.0 A THROUGH E CELLS DISMANTLING AND DECONTAMINATION

4.1 REMOVE CENTRIFUGES

- 4.1.1 DISCONNECT PIPING, ETC.
- 4.1.2 INITIALLY DECONTAMINATE OUTER CELL
- 4.1.3 MOVE TO AIRLOCK
- 4.1.4 PACKAGE AND REMOVE

4.2 ISOLATE CELLS

- 4.2.1 IDENTIFY, MARK, SURVEY PIPES, ETC.
- 4.2.2 ISOLATE PIPE/TUBING/CONDUIT AT GALLERY WALL
- 4.2.3 CUT INTERCELL PIPING

4.3 DISMANTLE PIPING

- 4.3.1 SECTION PIPING
- 4.3.2 IDENTIFY AS TRU OR NON-TRU
- 4.3.3 PACKAGE IN TANKS OR FOR TRU STORAGE

4.4 REMOVE EQUIPMENT FOR DISPOSAL

- 4.4.1 CONNECT EXHAUSTER TO TANK (P)
- 4.4.2 VERIFY NON-TRU STATUS (P)
- 4.4.3 LOAD TANKS WITH WASTE PIPE
- 4.4.4 SEAL AND INITIALLY DECONTAMINATE TANKS
- 4.4.5 MOVE EQUIPMENT TO AIRLOCK
- 4.4.6 DECONTAMINATE, PACKAGE AND DISPOSE

4.5 REMOVE EQUIPMENT FOR DISPOSAL

- 4.5.1 WASHDOWN CELLS (P)
- 4.5.2 DECONTAMINATE SPECIFIC AREAS
- 4.5.3 REMOVE PIPE BUNDLES
- 4.5.4 REMOVE C-7 TANK AND TRANSFER LINE (EO)
- 4.5.5 DISMANTLE AIRLOCK

(EO) - INDICATES ACTIVITIES THAT REQUIRE AN ENGINEERING ORDER AS A DESIGN MEDIUM.

(P) - INDICATES ACTIVITIES THAT REQUIRE PREPARATION OR REVISION OF PROCEDURES.

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Figure 4-6. A Through E Cells Dismantling and Decontamination Work Breakdown Structure.

There are two constraints controlling the order of work in these cells. The ventilation exhaust system is being connected to the same set of doors that are used for personnel access to the cells. As a result, the cells being worked in must be coordinated to ensure personnel access. It will not be possible to work in D and E cells simultaneously, since one door will be needed as an entrance. The other major constraint is that the transfer piping to B Plant and the C-7 tank that receives cell drainage must be the last equipment removed. This piping will be saved for collection of any wash water used in decontaminating the cells, and to provide a routing to B Plant and eventually the tank farms.

The D&D work in these cells will be performed by D&D workers with the exception of the work on the centrifuges. The centrifuges that have been identified as reusable equipment will be removed and decontaminated by other crafts.

4.2.4.1 Remove Centrifuges. The centrifuges in A, B, D, and E cells have been identified as reusable equipment. The centrifuges will be removed and decontaminated by crafts other than the D&D workers. To avoid any interference with D&D activities, the centrifuges will be removed before D&D work begins in the cells. Crafts personnel will disconnected the centrifuges from the piping, electrical, and instrument lines and release it from its mounting. Operators will decontaminate the exteriors of the centrifuges. The centrifuges will then be moved to the airlock.

In the airlock, the centrifuges will be further decontaminated and packaged for removal from the facility. Following removal, the centrifuges will be given to the operations groups that requested the equipment for further decontamination and refurbishment.

4.2.4.2 Isolate Cells. The tasks in this activity are intended to isolate the cells so work can proceed in any of them without impacting or being impacted by work in other cells or other parts of the building. The transfer piping between cells passes through openings in the cell dividing walls. The piping will be cut at the point it passes from one cell to the next. The pipelines will be coded according to type of service. Personnel protective clothing requirements will be dictated by the type of service the pipe was used for. The degree of contamination control required for cutting the pipes will be determined by drilling and swabbing the inside of the pipes and checking for the presence of radioactivity or liquids. It is expected that most lines will be dry due to the apparent care taken in flushing equipment when the facility was vacated and the elapsed time that has allowed for evaporation. The pipe will then be cut using tools such as hydraulic crimper/cutters, portable band saws, reciprocating saws or pipe cutters. If contamination is present, the cut area may be injected with foam that serves as a fixative or contained in a glove bag.

The piping, tubing, and conduit that enter the cell from the pipe gallery and that is located on the outside walls of the cells will similarly be cut to isolate the cells. Conduit that provides power to the cell lighting will remain intact. All lines that remain energized will be marked with signs to prevent accidental cutting. All other conduit will be checked by an electrician before it is cut. After the cells are isolated, the checks by the electrician will not be required.

4.2.4.3 Dismantle Piping. The piping within the cells will be removed using the same sequence discussed in 4.2.4.2 for isolating the cells. All pipelines will be identified as to past use. The piping will be drilled and swabbed to determine whether any liquids are present and to what extent the interior is contaminated. The piping will then be cut into lengths that can be safely handled by D&D workers working from ladders, portable scaffolding or Spider Staging scaffolding.

The piping will be segregated (based on past use). The process water and chemical feed piping will be disposed of as low-level waste (based on a survey using field survey instruments). Process and waste piping, steam piping, instrument tubing, in addition to any feed piping with high alpha contamination, will be selectively assayed to determine its TRU status.

Piping classified as TRU will be packaged for burial. Low-level waste piping will be packaged for onsite disposal. The tanks in the facility may be used for low-level waste disposal. Piping assayed as exceeding 100 nCi of transuranic contamination per gram of waste will be packaged as TRU waste.

4.2.4.4 Remove Equipment for Disposal. This activity will result in the removal of all equipment from the cells.

The tanks in the A through E cells can be used as burial container for some of the piping that is removed. In addition, one of the tanks (D-3) is currently a suspected TRU waste form. A portable exhauster, capable of providing a containing airflow into the tanks, will be connected at one of the flanged risers of each tank that is to be opened. The exhaust will be directed to the building exhauster intake.

At this point, a verifying assay of the tank interior will be made to confirm the non-TRU status that has been assigned the tanks (except D-3), based on the radiological characterization. If necessary, the tank interior will be decontaminated to reduce TRU contaminants and make the tank non-TRU waste.

With the exhauster connected to the tank, pipe will be loaded into the tank through the center opening. A structural analysis of the tanks (appendix F) establishes the load-bearing capacities of the tanks.

After a tank is filled, it will be disconnected from the portable exhauster and closed. Blind flanges will be bolted in place over the risers and the center opening.

The following activities apply to the tanks and the other equipment located in the cells (radiation detectors, lead shields, metal ventilation ducting, and sampler basins). The equipment will be loosened from its retaining mounts and subjected to exterior decontamination, if necessary. After being decontaminated, the equipment will be moved into an airlock where it will be surveyed and further decontaminated or packaged, or both, to make it acceptable for transport and disposal. The waste packages will be outloaded from the airlock and transported to the low-level waste burial ground for disposal.

4.2.4.5 <u>Decontaminate Cells</u>. The final activity in this work breakdown structure element is the removal of smearable contamination and higher dose fixed contamination in the cells. The selected decontamination technique will correspond to the difficulty of contaminant removal. The gutters are more contaminated than the remainder of the cells, and will probably require the removal of some of the concrete for decontamination. Concrete will be removed using chipping hammers, scabblers or a high-pressure water spray. The walls, being less contaminated, will be decontaminated by high-pressure spraying, washing and wiping. The crane and lights will be decontaminated to the extent that it is practicable or removed.

An RPT will survey the building surfaces for direct radiation, and will survey smears to determine whether additional decontamination is required.

Once the surfaces are decontaminated, the pipe bundles to the gallery and any pipes penetrating the cell walls will be removed. This will be done with chipping hammers, concrete saws, or core drills. Penetrating pipes will be removed at the wall separating E and F cell. Since F cell will still be contaminated and without exhaust ventilation, these activities will take place in a greenhouse.

Openings made in the wall will be temporarily covered until the final stages of work in the building. At that time, the holes will be grouted closed.

The C-7 tank that was left in the deep portion of C cell will be removed after it is determined that no more water will be generated in the building. At that time, any waste water will be sampled and transferred to tank farms. The tank and the transfer piping to B Plant will be blanked at the rear of the pipe tunnel. The pit and the tunnel will also be decontaminated. A concrete cap will be placed over the floor of the deep portion of C cell if it cannot be easily decontaminated.

The wooden doors in the cells will be removed and replaced rather than decontaminated. Door replacement, as well as other refurbishment work, is included in the close-out activities of the project, but may begin at this time.

4.2.5 F Cell Dismantling and Decontamination

The activities in this work breakdown structure element (fig. 4-7) will result in the removal of essentially all of the piping, tubing and equipment and most of the radioactivity in the F cell end of the building. This includes the F cell proper and the loadout area.

4.2.5.1 Establish Contamination Control. The first task will be to establish the physical means for providing contamination control during the dismantling and decontamination in F cell.

The HEPA-filtered exhaust system connected to the A through E cell doors will be connected to the F cell. In addition to connecting the exhaust system, the cracks and openings into the cell area will be sealed to minimize air infiltration.

A large airlock will be constructed on the outside of the wall that separates the cell from the loadout area. The metal wall panel will be removed and replaced with plastic curtains or a double-wide door to provide access into the airlock from the cells. Equipment and waste will be removed from F cell through the airlock and roll-up door on the north side of the building.

4.2.5.2 Dismantle Piping. Pipe removal in F cell will follow the same sequence as the A through E cell pipe removal. The piping will be removed from the tanks and the risers covered with plastic or blind flanges. The pipelines will be identified as to past use and marked to indicate order of removal. Each pipeline will be drilled and swabbed to determine the contamination control measures to be used when cutting. As the pipe is removed, it will be separated based on its contamination potential. The pipes with a high-contamination potential will be assayed to determine disposal status. Disposal is discussed in section 8.0.

4.2.5.3 Remove Equipment. The equipment to be removed from the F cell consists of centrifuges, tanks, agitators, sample boxes and a scale. The agitators can be removed from the tanks and replaced with blank covers. Two of the tanks, F-8 and F-9, have been assayed as containing enough TRU elements to be considered TRU waste. The tanks will be flushed to remove contaminants until assayed and determined to be non-TRU. This will require attaching a portable exhauster, spraying the inside (using an omni-directional spray head), and recovering the decontamination solution.

Following the tank decontamination, piping that is assayed as non-TRU may be deposited in the tanks, if this is deemed an efficient use of time. The smaller size of these tanks (4 ft by 5 ft), make the tanks less valuable as burial containers. The tanks will be closed and the exteriors decontaminated. After the tanks are moved into the airlock, the tanks will be surveyed and further decontaminated, or sprayed with a fixative, if necessary.

5.0 F CELL DISMANTLING AND DECONTAMINATION

5.1 ESTABLISH CONTAMINATION CONTROL

- 5.1.1 CONNECT HEPA EXHAUSTER
- 5.1.2 SEAL CELLS
- 5.1.3 CONSTRUCT LOADOUT AIRLOCK
- 5.1.4 HOUSEKEEPING

5.2 DISMANTLE PIPING

- 5.2.1 IDENTIFY, SURVEY, AND MARK PIPES/CONDUIT/TUBING
- 5.2.2 REMOVE PIPING FROM TANKS AND COVER FLANGES
- 5.2.3 CUT AND PACKAGE PIPING
- 5.2.4 ASSAY PIPING

5.3 REMOVE EQUIPMENT

- 5.3.1 DECONTAMINATE TWO TRU TANKS (P)
- 5.3.2 ASSAY, PACKAGE AND REMOVE CENTRIFUGES
- 5.3.3 PACKAGE AND REMOVE TANKS AND MISCELLANEOUS EQUIPMENT

5.4 DISMANTLE LOADOUT HOOD

- 5.4.1 ESTABLISH CONTAMINATION CONTROL
- 5.4.2 DISASSEMBLE/DECONTAMINATE HOOD
- 5.4.3 ASSAY, PACKAGE AND REMOVE F-10 TANK AND PIPING

5.5 DECONTAMINATE F CELL AREA

- 5.5.1 SURVEY FOR CONTAMINATION
- 5.5.2 DECONTAMINATE F CELL
- 5.5.3 DECONTAMINATE LOADOUT AREA
- 5.5.4 REMOVE AIRLOCK AND GREENHOUSE

(P) - INDICATES ACTIVITIES THAT REQUIRE PREPARATION OR REVISION OF PROCEDURES.

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Figure 4-7. F Cell Dismantling and Decontamination Work Breakdown Structure.

Other equipment will be decontaminated or packaged for disposal or both. The two centrifuges will be assayed to verify the TRU content. The centrifuges will be packaged and disposed of in a manner dictated by the contamination level.

4.2.5.4 Dismantle Loadout Hood. The F-10 tank and loadout hood are currently separated from the loadout area by a wood frame and plywood wall. The wall will be removed and replaced with a larger containment which will allow movement around the enclosure. The containment structure will be ventilated by a HEPA-filtered exhauster. The vessel vent connection for this hood is downstream of the isolation point; consequently, a pipefitter will have to disconnect the vent piping before D&D workers can begin. The HEPA-filtered exhauster can be connected to this pipe to provide air flow into the hood.

The hood is constructed of a metal frame with glass panels. As it is dismantled, the parts will be decontaminated to non-TRU levels if necessary, and packaged for low-level waste disposal. The F-10 tank and its feed piping will be removed and disposed of as TRU waste. The drip pan and the scale hardware associated with the tank will be decontaminated and disposed of as non-TRU waste.

4.2.5.5 Decontaminate F Cell Area. F cell and the loadout area building surfaces will be decontaminated after removal of all the piping and equipment. Because of the containments used, the contamination should be restricted to the cell and the area immediately around the loadout hood. The method of decontamination will depend upon the type of contamination found in specific areas. The walls and ceiling are the least contaminated and can be cleaned by washing and wiping. The floors, and in particular, the gutter and sumps, are more contaminated and may require the removal of part of the concrete to decontaminate. The decontamination will be coordinated with direct and smear surveys to ensure acceptable radiation levels for a controlled facility.

After decontamination has removed the potential for a contamination spread, the greenhouse and airlock will be removed. These will be disposed of as low-level waste. In addition, the wooden doors in F cell will be removed, disposed of, and replaced. Repairs to the building will be included in the project closeout activity.

4.2.6 Yard Piping Decommissioning

The yard piping decommissioning activity (fig. 4-8) involves the removal of a portion of the vessel ventilation air tunnel. The air tunnel has been characterized as non-TRU waste, however, a portion of it may be excavated and packaged for TRU storage. The north-south portion of the air tunnel is within 3 ft of an active B Plant waste transfer line. This portion of the system will not be removed by this project because of the

6.0 YARD PIPING DECOMMISSIONING

- 6.1 ESTABLISH CONTAMINATION CONTROL
  - 6.1.1 DESIGN MOVABLE CONTAINMENT
  - 6.1.2 CONSTRUCT/FABRICATE CONTAINMENT
  - 6.1.3 CONNECT HEPA-FILTERED EXHAUSTER
- 6.2 REMOVE AIR TUNNEL
  - 6.2.1 EXCAVATE TO AIR TUNNEL
  - 6.2.2 DRILL/SURVEY AND APPLY FIXATIVE
  - 6.2.3 CUT AND WRAP TUNNEL SECTION
  - 6.2.4 MOVE CONTAINMENT
  - 6.2.5 LOAD AND TRANSPORT TO TRU STORAGE
- 6.3 ISOLATE CELL WASTE LINES
  - 6.3.1 EXCAVATE TO DRAIN LINES
  - 6.3.2 ESTABLISH CONTAINMENT
  - 6.3.3 CUT AND PLUG LINES
  - 6.3.4 BACKFILL AREA/RESURFACE ROAD

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Figure 4-8. Yard Piping Decommissioning Work Breakdown Structure.

potential for high worker doses and the possibility of an accident affecting B Plant operations. After the B Plant is shut down and the waste line is no longer needed, it can be flushed to reduce radiation levels and workers can remove the remaining air tunnel at that time.

4.2.6.1 Establish Contamination Control. The first tasks of this activity will be to establish the contamination control necessary to cut the contaminated piping. A moveable containment will be designed and constructed. The containment will be equipped with a connector, which will be used for an exhauster, to keep the containment at a negative pressure.

4.2.6.2 Remove Air Tunnel. The tunnel removal will be a sequential operation: the size of the segment of tunnel that will be removed will be determined by the capacity of the available equipment.

Machinery will be used for the initial excavation down to and around the air tunnel. A radiological survey of each bucket of dirt will be conducted to ensure that when contaminated soil is exposed, the necessary controls of wetting and/or greenhousing will be used to finish the contaminated portion of the excavation. The excavation will be maintained in a safe condition through compliance with safety requirements for excavations.

The yard piping decommissioning work breakdown structure element (see fig. 4-8) outlines the isolation of the cooling water drains and removal of a portion of the vessel ventilation air tunnel. The main trunk of the air tunnel has been characterized as non-TRU waste and will be disposed of in a low-level waste burial ground. The laterals are assumed to be TRU waste and will be removed and packaged for storage.

After the excavation has exposed the air tunnel, the moveable greenhouse will be moved over the section of tunnel to be cut. A hole will be drilled in the area of the cut to provide access to the pipe interior. A fixative will be applied in the cut zone through the drilled hole. After the fixative has dried, the concrete will be severed at this location.

After each section is cut loose, the ends will be covered to contain any contaminants. Rigging lines will be passed under the concrete tunnel section and it will be lifted into a burial box. This process will continue until approximately 190 ft of the air tunnel is removed.

Occasionally, measurements will be made following drilling tasks to determine the TRU contamination levels in the tunnel. If concentrations exceed the 100 nCi/g limit for TRU waste, those tunnel portions will be packaged and stored as TRU waste.

Hand-dug excavations will be made to expose the laterals between the building and the ventilation tunnel. The laterals are constructed of bell-end clay pipes, which are likely to have leaked at the joints. It is therefore expected that soil below the pipe will have to be excavated and packaged for disposal. Any soil that contains TRU contamination above 100 nCi/g will be excavated and removed for TRU storage. Other contaminated soil will be removed as necessary.

Following the removal of the air tunnel and the contaminated soil, the excavations will be backfilled with clean soil. This work will be coordinated with the excavations to isolate the waste water lines in the following activity.

4.2.6.3 Isolate Cell Waste Lines. There are 11 waste lines exiting the cells that will be left in an isolated condition. Ten of these are tank-jacket cooling water drains that are not expected to be contaminated. The other line was a process waste line, but it has been isolated as part of a diversion box isolation activity, Project B-231.

The lines will be exposed by excavating along the south wall of the building. After the line is exposed, the pipe will be drilled and swabbed to determine whether it is contaminated. If contamination is detected, a containment will be placed over the pipe during the isolation. A section of pipe will be cut out of each of these and a plug or blank placed over each end.

After all of these activities are completed, the area will be returned to near original condition. Backfill will be brought in to fill the excavations to grade, and the roadway will be surfaced with rock and gravel.

4.2.7 Project Closeout

The activities in this work breakdown structure element (fig. 4-9) include the physical refurbishment required to leave the building in a safe condition, and the documentation to confirm and report the D&D activities that were performed.

4.2.7.1 Confirm Radiological Condition. The final radiological condition of the facility must be determined and documented to demonstrate compliance with the criteria for a controlled facility. An RPT will work closely with the D&D workers during the decontamination phase of the project. The RPT will record the results of a final survey and mark those areas containing residual (fixed) contamination. These areas will be painted in accordance with established practices (see section 3.0). In addition, instrumentation capable of detecting extremely low exposure rates will be brought into each cell to verify that the exposure criterion is met.

4.2.7.2 Repair Facility. During the D&D activities, holes were created through both inside and outside walls to remove piping. In addition, the sumps and gutters may have been chipped to remove embedded contamination. These openings and surfaces will be refinished with concrete. The concrete may also serve to shield some of the fixed contamination that remains in the concrete.

7.0 PROJECT CLOSEOUT

- **7.1 CONFIRM RADIOLOGICAL CONDITION**
  - 7.1.1 SURVEY A THROUGH E CELLS
  - 7.1.2 TAKE EXPOSURE READINGS IN A THROUGH F CELLS
  - 7.1.3 SURVEY F CELL AREAS
  - 7.1.4 TAKE EXPOSURE READING IN F CELL AREAS
- **7.2 REFURBISH BUILDING**
  - 7.2.1 REPLACE DOORS
  - 7.2.2 REPAIR OPENINGS THROUGH WALLS
  - 7.2.3 REPAIR SUMPS/GUTTERS/FLOORS WITH CONCRETE
  - 7.2.4 PLACE GRATING OVER INTERIOR VENTS
  - 7.2.5 PLACE RAIN CAPS ON ROOF VENTS
  - 7.2.6 PAINT RESIDUAL CONTAMINATION AREAS
- **7.3 RETURN FACILITY TO NORMAL SERVICES**
  - 7.3.1 INSPECT FOR SAFE TERMINATION OF ELECTRICAL/PIPING
  - 7.3.2 RECONNECT/RE-ENERGIZE SERVICES
  - 7.3.3 DISCONNECT TEMPORARY SERVICES
- **7.4 DOCUMENTATION**
  - 7.4.1 PREPARE EOs TO REFLECT BUILDING CHANGES
  - 7.4.2 PREPARE CLOSEOUT REPORT
  - 7.4.3 POST FACILITY

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Figure 4-9. Project Closeout Work Breakdown Structure.

The supply ducting between the gallery side and cells will be left open to allow the building supply system to heat and ventilate the cells. A grating will be placed over each of the openings in the pipe gallery. The roof openings will be fitted with rain caps and screen (following decontamination) to allow ventilation, but to prevent bird intrusion.

The wooden doors leading to the cells will be replaced with exterior-quality lockable doors.

4.2.7.3 Return Facility to Normal Services. Portions of the facility services were terminated when the D&D activities began. This task will make any repairs necessary and return the facility services to active service. An electrician will check to ensure that all electrical lines have been terminated. Unterminated lines will be terminated in a safe manner, and the circuits remaining in the building will be energized. A pipefitter will place blind flanges on any of the pipelines that were left in the building. The services can be returned to the entire building, after these items have been secured.

The temporary services that were established to support the D&D work will be removed after the other utilities are returned to service.

4.2.7.4 Prepare Documentation. The final project activity is the documentation of the effects of the D&D work. The actions taken, and the results and lessons learned from the project, will be presented in a closeout report. Additional documentation is necessary to maintain configuration control in the drawing files. The drawings, which apply to other similar facilities, will be annotated to indicate the final condition of the building.

The final documentation needed at the facility is radiological posting. The doors into the cells will be posted with Controlled Facility signs indicating that the disturbance of any of the building surfaces requires radiological monitoring. Postings will also indicate the presence of underground radioactivity in the area of the air tunnel that remains.

5.0 COST AND SCHEDULE

The decontamination of 224-B is estimated to cost approximately $2.5 million and will be completed at the end of FY 1987.

The costs do not include funds for an exhauster for cell ventilation. It is expected that a portable exhauster will be obtained using capital funds for the ventilation system. Another cost not included in the project is a safety engineer. The safety engineer who will monitor D&D work will be funded from company overhead.

Table 5-1 shows the yearly cost breakdown by working group or cost item. Figure 5-1 is a schedule showing physical work beginning in FY 1986 and finishing at the end of FY 1987.

Table 5-1. 224-B Decommissioning Cost Estimate.

Category	Cost[a] (x$1,000)		
	FY 1985	FY 1986	FY 1987
Program Office	10	30	50
Readiness review	--	30	--
Engineering	110	168	176
D&D Operations	--	316	362
Radiation Protection	94	137	144
Planner	--	60	65
Quality Assurance	3	40	39
Other crafts[b]	6	60	75
Laundry	--	40	42
Waste disposal	--	70	205
Material	1	50	142
Subtotal	224	1,001	1,300
Contingency @ 25%	--	250	325
Annual total	224	1,251	1,625
TOTAL PROJECTED COST			3,100[c]

[a]Costs are in programmatic dollars and are shown in year of expenditure.

[b]Other crafts includes concrete finishers, carpenters, electricians, pipefitters, HVAC workers, chemical operators, equipment operators, and riggers.

[c]The project total does not include the cost of a safety engineer or the ventilation system for 224-B cells. Safety is charged to overhead and the ventilation system is a capital expenditure.

LINE No.	WBS No.	DESCRIPTION
1	1.0	PROJECT PLANNING & CONTROL
2	1.1	PREPARE PROJECT PLAN
4	1.2	PREPARE ENVIRONMENTAL DOCUMENTATION
6	1.3	PREPARE SAFETY ANALYSIS REPORT
8	1.4	PERFORM READINESS REVIEW
12	2.0	MOBILIZATION & BUILDING PREPARATION
14	2.1	INSTALL VENTILATION SYSTEM
16		SEAL OPENINGS
18	2.2	PROVIDE PERSONNEL NEEDS
20	2.3	HOUSEKEEP IN CELLS (A to E)
22	2.4	ESTABLISH AIRLOCKS
24		AIRLOCKS ON OUTSIDE DOORS
26		AIRLOCK ON LOADOUT DOORS
28	2.5	MODIFY FACILITY
30		CONNECT DRAINS TO C-7
32		CUT OPENINGS BETWEEN CELLS
34		ISOLATE OUTSIDE SYSTEMS
36	2.6	PREPARE CRANE FOR SERVICE
38		CRANE INSPECTION
40		REPAIR & LUBRICATE
42	2.7	PROVIDE D & D UTILITIES
44		PREPARE EO's
46		PROVIDE NEEDED UTILITIES
48		ISOLATE SELECTED CIRCUITS
50		ISOLATE OTHER UTILITIES
54	3.0	GALLERY DISMANTLING
56	3.1	REMOVE STUD WALLS
58	3.2	REMOVE MISCELLANEOUS EQUIP/DEBRIS
60	3.3	DISMANTLE DISPOSE OF PIPING, ETC.
62		IDENTIFY, SURVEY & LABEL
64		REMOVE THIRD FLOOR PIPING
66		REMOVE SECOND FLOOR PIPING
68	3.4	REMOVE REMAINING EQUIPMENT
70		FLOOR OPENING COVERS
72		REMOVE PANELBOARDS
74		REMOVE TANKS/PUMPS
76		REMOVE SCALES/FRAMES
80	4.0	A-E CELL DISMANTLING & DECON
81	4.1	REMOVE CENTRIFUGES
83		DISCONNECT PIPING, ETC
85		INITIALLY DECON OUTSIDE
87		MOVE TO AIRLOCK
89		PACKAGE & REMOVE

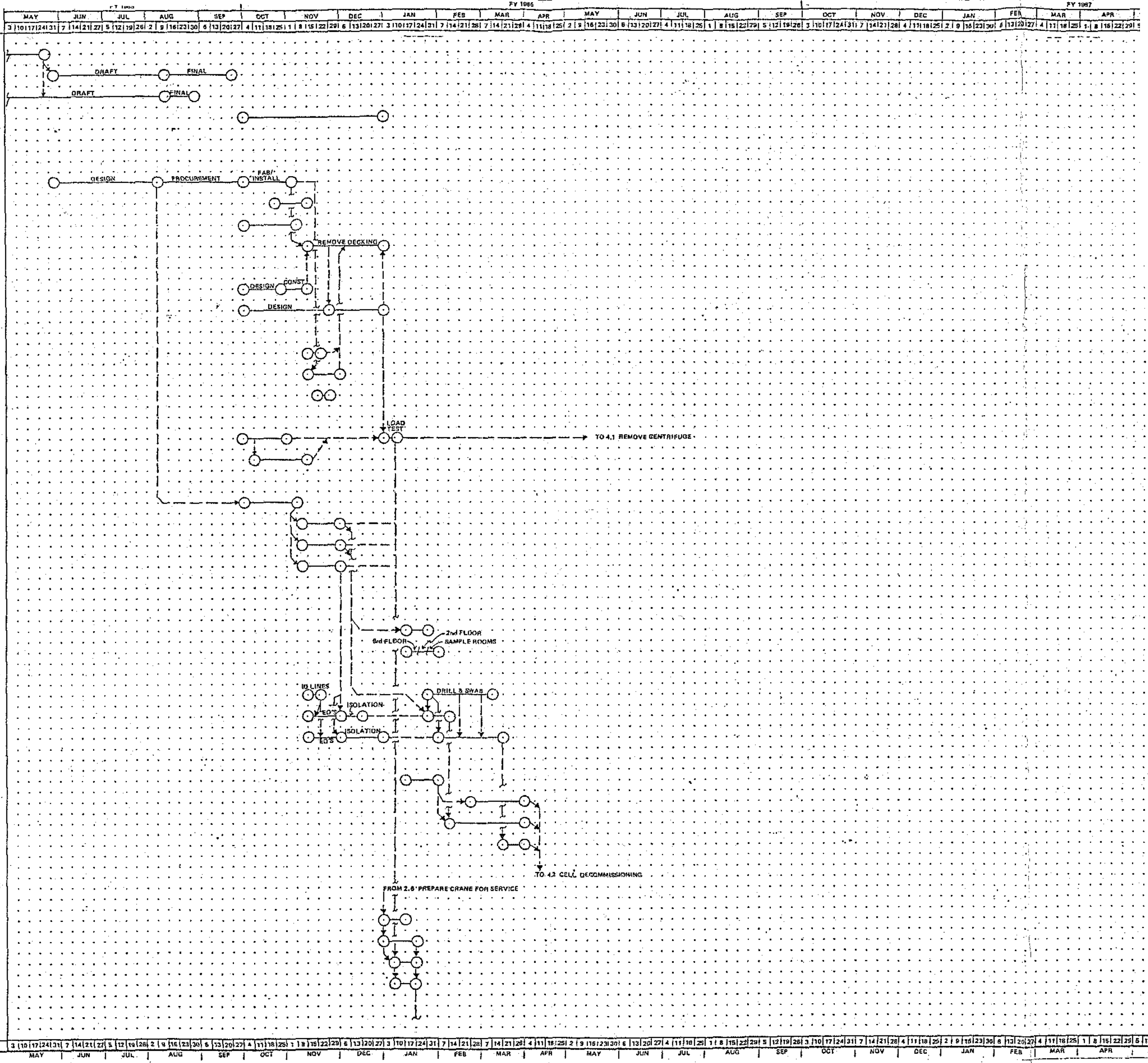
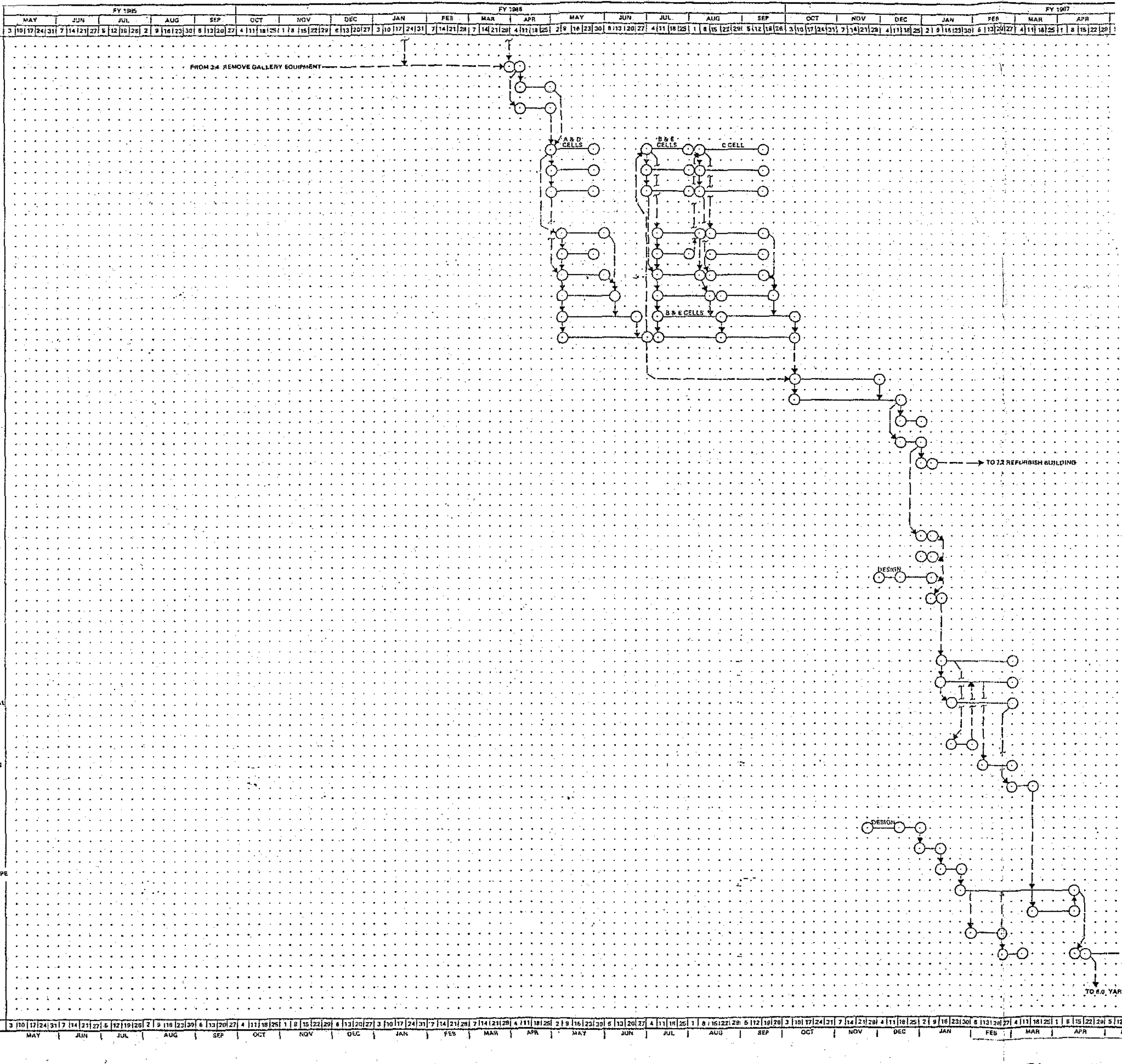
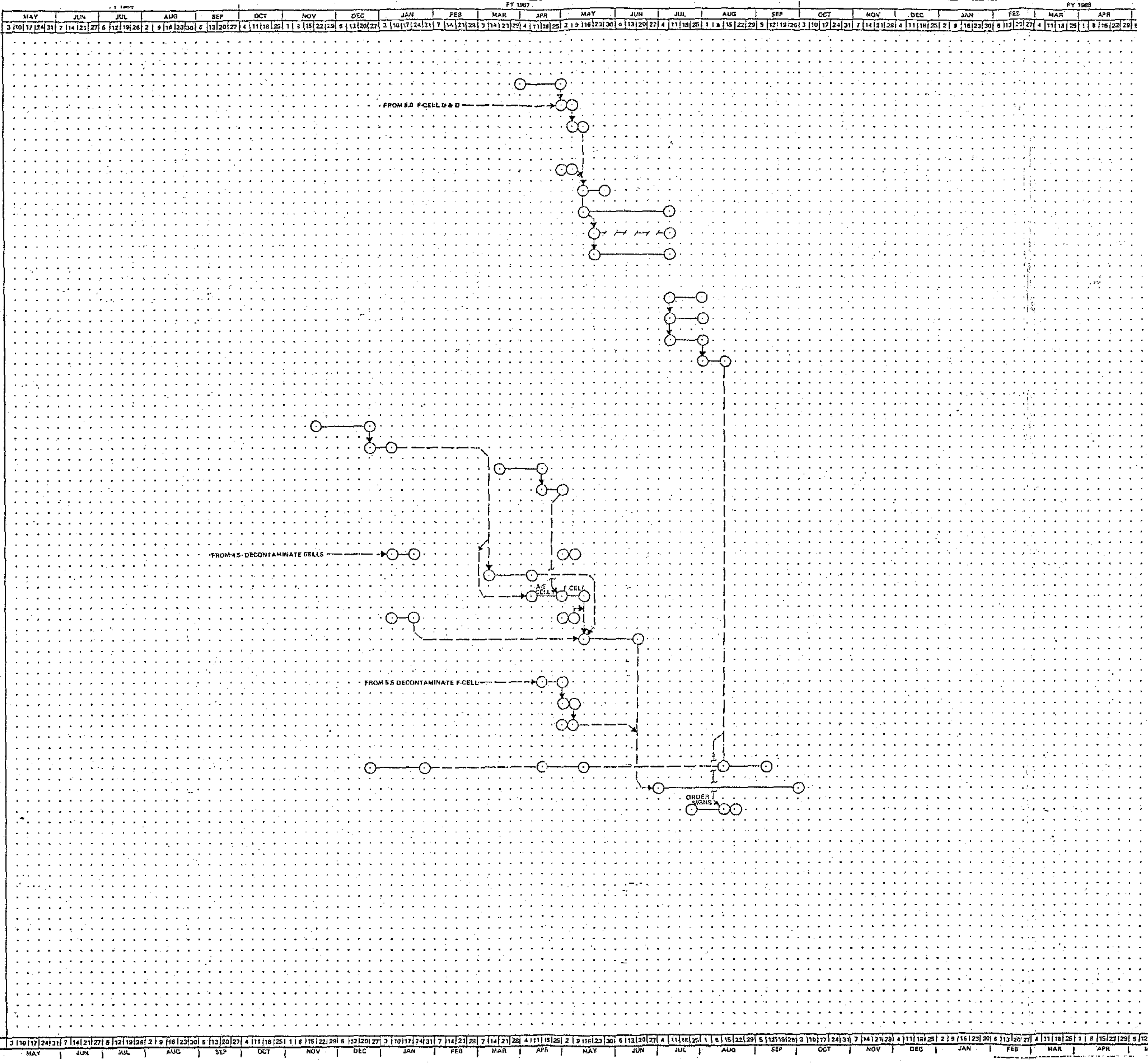


Figure 5-

LINE No.	WBS No.	DESCRIPTION
1	4.2	ISOLATE CELLS
2		
3		ID, MARK, SURVEY, PIPES, ETC
4		
5		ISOLATE PIPE, ETC AT GALLERY WALL
6		
7		CUT INTERCELL PIPING
8		
9	4.3	DISMANTLE PIPING
10		
11		SECTION PIPING
12		
13		IDENTIFY AS TRU VS. NON-TRU
14		
15		PACKAGE FOR STORAGE/DISPOSAL
16		
17	4.4	REMOVE EQUIPMENT FOR DISPOSAL
18		
19		CONNECT EXHAUSTER TO TANK(S)
20		
21		VERIFY NON-TRU STATUS
22		
23		LOAD TANKS WITH WASTE PIPE
24		
25		SEAL & INITIAL DECON TANKS
26		
27		MOVE EQUIPMENT TO AIRLOCK
28		
29		DECON, PACKAGE & DISPOSE
30		
31	4.5	DECONTAMINATE CELLS
32		
33		WASH CELLS
34		
35		DECON SPECIFIC AREA
36		
37		REMOVE PIPE PENETRATIONS
38		
39		REMOVE C-7 & TRANSFER LINE
40		
41		DISMANTLE AIRLOCKS
42		
43		
44		
45		
46	5.0	F CELL DISMANTLING &
47		DECONTAMINATION
48	5.1	ESTABLISH CONTAMINATION CONTROL
49		
50		CONNECT HEPA EXHAUSTER
51		
52		SEAL CELL
53		
54		CONSTRUCT LOADOUT AIRLOCK
55		
56		HOUSEKEEP
57		
58	5.2	DISMANTLE PIPING
59		
60		IDENTIFY/MARK/SURVEY PIPES, ETC.
61		
62		REMOVE & PACKAGE PIPING, ETC
63		
64		ASSAY & PACKAGE FOR STORAGE/DISPOSAL
65		
66	5.3	REMOVE EQUIPMENT
67		
68		DECON 2 TRU TANKS
69		
70		ASSAY PACKAGE & REMOVE CENTRIFUGES
71		
72		PACKAGE & REMOVE TANKS/
73		MISC. EQUIPMENT
74	5.4	DISMANTLE LOADOUT HOOD
75		
76		ESTABLISH CONTAMINATION CONTROL
77		
78		DISASSEMBLE/DECON HOOD
79		
80		ASSAY, PACKAGE & REMOVE F-10 TANK, PIPE
81		
82		
83	5.5	DECONTAMINATE F-CELL AREA
84		
85		SURVEY FOR CONTAMINATION
86		DECONTAMINATE F-CELL
87		
88		DECONTAMINATE LOADOUT AREA
89		
90		
91		REMOVE/AIRLOCK & GREENHOUSE
92		
93		
94		



LINE No.	WBS No.	DESCRIPTION
2	6.0	YARD PIPING DECOMMISSIONING
3	6.1	ESTABLISH CONTAMINATION CONTROL
5		DESIGN MOVEABLE CONTAINMENT
7		CONSTRUCT FABRICATE CONTAINMENT
9		CONNECT HEPA-FILTERED EXHAUSTER
11	6.2	REMOVE AIR TUNNEL
13		EXCAVATE TO AIR TUNNEL
15		DRILL/SURVEY & APPLY FIXATIVE
17		CUT & WRAP TUNNEL SECTION
19		MOVE CONTAINMENT
21		LOAD & TRANSPORT FOR DISPOSAL
23	6.3	ISOLATE CELL WASTE LINES
25		EXCAVATE TO DRAIN LINES
27		ESTABLISH CONTAINMENT
29		CUT & PLUG LINES
31		BACKFILL/RESURFACE ROAD
35	7.0	PROJECT CLOSEOUT
37	7.1	CONFIRM RADIOLOGICAL CONDITION
39		SURVEY A-E CELLS
41		TAKE EXPOSURE READINGS A-E CELLS
43		SURVEY F-CELL AREAS
45		TAKE EXPOSURE READINGS F-CELL
47	7.2	REFURBISH BUILDING
49		REPLACE DOORS
51		REPAIR OPENINGS THROUGH WALLS
53		REPAIR SUMPS/GUTTERS/FLOORS
55		REPLACE VENTILATION OPENING COVERS
57		PAINT RESIDUAL CONTAMINATION AREAS
59	7.3	RETURN FACILITY TO NORMAL SERVICES
61		INSPECT FOR SAFE TERMINATION
63		RECONNECT/REENERGIZE SERVICES
65		DISCONNECT TEMP. SERVICES
67	7.4	DOCUMENTATION
69		PREPARE ED'S TO REFLECT BUILDING CHANGES
71		PREPARE CLOSEOUT REPORT
73		POST FACILITY



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6.0 SAFETY

This section identifies known or possible conditions that require specific attention for the job to proceed safely. The measures that will be employed to ameliorate the unsafe conditions during the D&D operation are briefly discussed.

6.1 RADIOLOGICAL SAFETY

All of the D&D work in the cells and some of the work in the galleries, will have a radiological hazard associated with it. A combination of physical and administrative controls will be used to control the radiation hazards.

6.1.1 Containment

The containment of the radioactivity in the cells, tanks and pipeline has been discussed in section 4.2. To summarize, HEPA-filtered exhausters will be connected to the building and tanks to maintain airflow into rather than out of contaminated areas. Airlocks will be used at doors that will be used to move personnel or equipment in and out of the building.

Additional methods of containing radioactivity are decontamination, fixing, and wrapping in plastic. These methods will be used to prevent contamination spread as equipment and burial boxes are removed from the building. To improve the differential pressure between the cells and outside, areas suspected of leaking air will be caulked, taped closed or otherwise sealed.

6.1.2 Criticality Controls

An estimate of the ^{239}Pu inventory was made from data gathered during the radiological characterization of the facility. The gamma fluxes from ^{137}Cs and ^{241}Am were measured in facility dust and in tanks, then extrapolated to provide an estimate for gamma flux in pipes and the rest of the facility. A ratio of ^{241}Am to ^{239}Pu was developed from dust samples and scraping from flanges and pipes. This data was then used to estimate an inventory of 505 g of plutonium in 224-B. This inventory and subsequent estimates will be evaluated to determine if criticality controls will be necessary in the facility.

The controls, as presented in criticality prevention specifications, will primarily address the control of geometries, the reduction of reflectors and moderators, and the use of poisons. For example, when pipelines that may contain liquids are being breached, a critically safe catch bag may be used. It may be necessary to delay the use of water washes in the cells until there is a certainty that the fissile material inventory has been reduced to a safe level. Raschig rings may be placed in the C-7 catch tank to prevent wash waters and fissile contaminants that collect in the tank from becoming a criticality problem.

6.1.3 Personnel Protection

Methods and dress requirements for working in radioactive or potentially radioactive environments will be established to protect personnel from exposure and contamination. The radiological survey indicates that exposure will not be a significant problem in this facility. The measured radiation levels were generally less than 1 mrad/h for beta-gamma radiation and less than 0.1 mrem/h for neutron. The exception is the deep portion of C cell, where beta-gamma radiation is about 3 mrad/h and some of the piping is 20 mrad/h at contact. These levels are not high enough to necessitate stringent protective measures, but work time in these areas will be kept at a minimum. Additional dosimetry (pencil dosimeters and finger rings) will be worn by workers to monitor and maintain their exposure below the prescribed levels.

Normally, two pairs of anticontamination clothing and a respirator will be worn in the cells. When initially breaking pipes in the galleries, additional protection will be provided through the wearing of an acid or water repellent suit. The RPT that follows the job may invoke more or less stringent controls depending on the radiation environment encountered. The radioactive environment will be monitored using portable, hand-held instruments and by continuous alpha air monitors located near the work areas.

6.2 INDUSTRIAL SAFETY

This D&D project will pose industrial safety hazards similar to those encountered on a construction site. There are additional hazards associated with chemicals and hazardous materials used in the process or equipment. All of the D&D activities in 224-B will be conducted in compliance with RHO-MA-221, Accident Prevention Standards.

In accordance with RHO-MA-221, Accident Prevention Standards, tasks that are identified as presenting a high-risk potential will have a job safety analysis (JSA) conducted. Hazards will be identified in procedures, pre-job safety plans, hazardous work permits, or in the specific JSAs. The JSA is prepared by the D&D Operations Manager and is reviewed and approved by the responsible safety engineer.

As mentioned in section 4.2, crafts will be used to isolate systems that D&D workers will be dismantling. This is necessary to prevent the possibility of electrical shock or other hazards that would result from cutting into an active system. Any systems left in an energized state during D&D activities will be appropriately tagged to prevent disturbance.

Fire prevention will be practiced during D&D by minimizing the amount of flammable material brought into the building. Any construction materials used during D&D will be fire resistant or fire retardant. The fire-resistant or fire-retardant quality will be maintained by following the manufacturer's recommendations. Portable fire extinguishers will be available in the work area.

There are also industrial hygiene hazards associated with this project. Since 224-B was a chemical processing facility, there is a potential for residual chemicals in the pipelines. This is considered unlikely from facility inspections, but the possibility will be considered when breaking lines. Pipelines will be checked on both sides of valves for liquid content prior to cutting. A list of the chemicals that were used in the 224-B concentration process are listed in appendix D.

Additional industrial hygiene hazards are present or potentially present in the galleries. Detectable levels of mercury (see appendix E) were found during a survey in FY 1985. These levels are probably residue from previously broken panelboard instruments. The panelboards also contain oil in the air filters, which may contain PCBs. As deemed appropriate by an industrial hygienist, the area will be posted and workers will wear protective clothing while disassembling the panelboards and cleaning the galleries.

Asbestos lagging will have to be removed from some of the piping before it can be cut. An established procedure will be followed while removing the asbestos. Access will be restricted to the area where asbestos is being removed. Workers in the area will wear disposable coveralls and a full-face respirator and use wet techniques while cutting to minimize dispersal. The workers will also shower before lunch and at the end of the day.

6.3 SAFETY DOCUMENTATION

Prior to starting D&D work in 224-B, environmental documentation and a safety analysis report will be prepared. These activities are discussed in section 4.2.1.

Additional safety documentation is prepared, such as JSAs, criticality safety analysis reports, criticality prevention specifications, and review comment records. The review comment record is a formal method for representatives of the various safety disciplines to transmit comments on design media and procedures. Signoff of the design media or procedures follows resolution of the safety comments.

7.0 QUALITY ASSURANCE

Quality assurance associated with the D&D of 224-B will have two purposes: provide assurance that specified products and services meet necessary standards, and provide analytical and assay services.

7.1 QUALITY ASSURANCE PROGRAM

The quality assurance program for the 224-B D&D project will be based upon ANSI/ASME Standard NQA-1 as endorsed by DOE-RL Order 5700.1A. Policies and procedures that define the proper response to quality and safety aspects of ANSI/ASME Standard NQA-1 are outlined in existing Rockwell documents. These documents will be specified in the 224-B Project safety analysis report. The applicable quality assurance requirements will be imposed by project management with functional management concurrence.

Quality assurance reviews and inspections will primarily include personnel training, design support, inspection and procurement where these areas have a safety impact. Personnel training records will be reviewed to ensure that personnel working on the project have adequate training for performing their jobs. Design documents will be reviewed by a quality engineer who will prepare a verification or inspection plan if it is needed. A quality control inspector will perform the field inspections required by the inspection plan. Procurement quality assurance will monitor suppliers to ensure that the proper quality and safety standards are met and will provide quality verification of purchased products.

7.2 RADIOLOGICAL MEASUREMENTS

Services of the Analytical Laboratories Department will be used in establishing levels and inventories of radionuclides in certain waste products. Nondestructive assay techniques will be used in determining the levels of TRU activity in piping and equipment. Wet chemistry and radioactivity counting will be employed to determine the disposal mode of liquid waste collected in the facility.

All radiation measurement instruments, including hand-held field instruments, will be calibrated to a recognized national standard.

8.0 WASTE HANDLING

The dismantling of equipment and piping and the decontamination of building surfaces will result in solid and liquid waste, as well as TRU and nonTRU and noncontaminated waste. The estimated volumes of each of these waste types is presented in table 8-1.

Solid waste will consist of the equipment and materials removed from the building and the materials used (plastic, wipes) to contain or clean contaminants. Material removed from the pipe and operating galleries will be radiologically surveyed to determine its status. The frame wood walls are expected to be noncontaminated and will be disposed of in the Hanford Site central landfill. The rest of the equipment will be disposed of as low-level waste, unless it is found to be TRU. Hazardous materials such as PCBs, mercury or asbestos will be disposed of in accordance with existing regulations at the time of removal.

Table 8-1. Estimated Waste Volumes From 224-B Decommissioning.

	Solid (ft^2)	Liquid (gal)
TRU waste	2,700	Not applicable
Non-TRU waste	22,000	30,000
Noncontaminated waste	600	Not applicable

The tanks in the cells are known to be contaminated and a significant effort will be made to decontaminate the tanks, as necessary, to non-TRU levels (less than 100 nCi/g of matrix). These tanks will be filled to a given weight limit (see appendix F) with non-TRU piping removed from the cells, closed with blind flanges and used as shipping and burial containers. Use of the tanks as shipping containers will require the preparation of a safety analysis report for packaging. The pipelines will be nondestructively assayed using a sodium iodide system and techniques established at the plants on site. Pipelines will be sectioned and a series of measurements made with particular attention paid to suspected regions of radiocontaminant accumulation (e.g., low points, corners). If a pipeline is determined to be TRU waste, it will be packaged for TRU storage instead of being disposed of in the tanks.

Solid waste determined to be TRU will be packaged in containers and certified for storage at WIPP. Pipes will be packaged in TRU burial boxes that can handle longer sections of pipe, thereby minimizing the number of cuts necessary for dismantlement. Wipes used for decontamination, contaminated clothing and miscellaneous small waste items will be packaged in the less expensive TRU waste drums.

Liquid waste will be generated from tank as well as general facility decontamination. Any of the liquid waste that exceeds radioisotope limits for ground disposal (per DOE Order 5480.1A), or has chemical characteristics making it unsuitable for discharge to the environment will be transferred to tank farms. There is a pipeline between 224-B and B Plant that would allow transfer to tank farms via a B Plant cell. The waste will be sampled from a collection tank in C cell and analyzed for transuranic content. The waste will also be sampled and analyzed as it leaves B Plant.

Some of the later washes in the cells may be low enough in radioactivity to be discharged to an existing liquid disposal site. This waste will be routed to the chemical sewer manhole on the north side of 224-B Building.

The amount of transuranic material routed through B Plant will be controlled to prevent the criticality status of the facility from being affected. If it appears that the liquid waste has excessive concentrations of TRU material, it will be transferred to the tank farms in a tank truck.

9.0 REFERENCES

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DOE, 1981, Environmental Protection Safety, and Health Protection Program for DOE Operations, DOE Order 5480.1A, U.S. Department of Energy, Washington, D.C.

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Gould, J. I. and G. L. Troyer, 1985, Radiological Characterization of the 224-B Hot Cells SD-DD-TRP-003, DRAFT, Rockwell Hanford Operations, Richland, Washington.

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Owens, K. W. and J. C. Sabin, 1984, Long-Range Decommissioning Plan for Rockwell Hanford Operations Surplus Facilities Management Program, RHO-WM-PI-10, Rockwell Hanford Operations, Richland, Washington.

Rockwell, 1978, Accident Prevention Standards, RHO-MA-221, Rockwell Hanford Operations, Richland, Washington.

Rockwell, 1983a, Hazardous Material Packaging, Shipping, and Transportation Manual, RHO-MA-201, Rockwell Hanford Operations, Richland, Washington.

Rockwell 1983b, Radiological Standards and Operational Controls, RHO-MA-220, REV 1, Rockwell Hanford Operations, Richland, Washington.

Rockwell, 1983c, Hanford Radioactive Solid Waste Packaging, Storage, and Disposal Requirements, RHO-MA-222, REV 1, Rockwell Hanford Operations, Richland, Washington.

Six, D. E., 1983, Nuclear Materials Control and Accountability Plan, RHO-MA-113, REV 1, Rockwell Hanford Operations, Richland, Washington.

APPENDIX A

224-B EQUIPMENT LIST

Item	Qty.	Description	Property no.
1. Tank	10	9 ft dia by 9 ft high; stainless steel; steam jacket	F185137-144-169, -170, -193, -194, -222, -229, -254, -255
2. Tank	7	4 ft-6 in. dia by 7 ft high; 0.188 in. mild steel; steam jacket; 12 top nozzles; 745 gal; 2,685 lb empty	F185136, -167, -168, -195, -198, -221, -253
3. Tank	4	4 ft dia by 5 ft high; 0.25-in. stainless steel; steam jacket; 2 ft dia manhole; 12 top nozzles; 415 gal; 1,750 lb empty	F1852181, -282, -283, -284
4. Tank	2	Small approximately 1 ft-6 in. dia by 2 ft high; stainless steel	F185298, -299
5. Tank	1	3 ft-6 in. dia by 5 ft-11 in. high; 0.188 stainless steel; 400 gal; 1,000 lb empty; 75 psi; dished bottom	F185142
6. Tank	4	2 ft-6 in. dia by 2 ft-8 in. high; 0.188 stainless steel; 75 gal; 450 lb empty	F185140, -226, -258, -263
7. Tank	4	Approximately 30 gal	F185136, -165, -220, -251
8. Tank	1	Approximately 3 ft-6 in. dia by 5 ft high; 0.25 in. carbon steel; 380 gal; 1,025 lb empty; 75-psi pressure vessel; dished top and bottom	Unknown

Item	Qty.	Description	Property no.
9. Agitator	6	15 HP at 1,750 RPM; output; 68 RPM; currently configured with item 1; the motor is missing from one of the agitators	F185118, -178, -179, 204, 230, UNK
10. Agitator	4	5 HP at 1,150 RPM; output-146 RPM; currently configured with item 2; motors are missing from three of the agitators	F185117, -145, UNK, UNK
11. Agitator	3	1 HP at 1,750 RPM; output-188 RPM; currently configured with item 3	F185264, -265, -266
12. Agitator	2	Currently configured with item 4	F185291, -292
13. Centrifuge	4	40-in. bowl; stainless steel	F185120, -150, -205, -236
14. Centrifuge	2	26-in. bowl; stainless steel	F185267, -268
15. Centrifuge	1	Small; estimate 8 in. to 12 in. bowl	F185293
16. Scale	6	Two scales still have tanks (items 5 and 8) associated with the scales; 6,000 lb capacity	F185143, -224
17. Pump	4	Pumps are configured with tanks (item 7) 7.5 HP, 60 cycle, 3 phase; General Electric Model 5KF254C25	F185135, -166, -219, -250
18. Microammeter	6	Beckman Instrument, Model RXG	F185124, -153, -184, -208, -238, -270

Item	Qty.	Description	Property no.
19. Multiswitch	6	Range Switches; Beckman Instruments, Model RSG	F185132, -163, -191, -248, -277, UNK
20. Recorder	21	Circular Chart; made by Ring Balance Instrument & Co.	F185125 through -131, F185154 through -159, -161 -162, F185185
	18	Strip Chart; made by Leeds & Northrup Co.; (face has been removed from one)	through -190 F185209, -210, -212 -213, -216, -217, F185241, -242, -243 -245, -247, F185271
21. Vibration meter	4	Made by Islip Radio Mfg. Corp.	through -276, F185295, -296, -297 UNK, UNK
22. Tank	1	4 in. by 3 ft by 2 ft 8-in. high stainless steel	F185286
23. Scale	1	Associated with tank in item 22	F185287

APPENDIX B

RADIOLOGICAL CHARACTERIZATION DATA

The 224-B facility has been characterized to determine the radiological conditions that will be encountered during the D&D project and to establish a radiological inventory. Measurements were made with portable field instruments and mobile radioanalysis equipment.

The following portable field instruments were used in the characterization:

- Snoopy for neutron exposure rates
- Cutie Pie for beta-gamma dose rate
- Reuter-Stokes ion chamber for beta-gamma dose rate
- Geiger-Mueller (G-M) detector with a P-11 probe for beta-gamma surveying
- Portable alpha monitor (PAM) for alpha surveying.

The mobile radioanalysis equipment was used for taking in-place measurements in the cell and for isotopic analyses of smears and samples. The instrumentation included the following:

- Intrinsic germanium (IG) detector with a multichannel analyzer (MCA) for gamma energy analysis
- Lithium-drifted silicon (SiLi) detector with a multichannel analyzer (MCA) for gamma energy analysis
- Phoswich detector for strontium analysis.

A detailed description of the radiological characterization techniques and results is reported in the radiological characterization (Gould and Troyer 1985). Summary information by cell is reported in the following pages.

Direct and smear surveys were conducted in the gallery during the radiological characterization. No detectable radiation was found during these gallery surveys.

B.1.0 A CELL DATA

B.1.1 DOSE/EXPOSURE RATES

B.1.1.1 Snoopy Measurements

Measurements were taken at six locations adjacent to the tanks and centrifuge: all <0.1 mrem/h.

B.1.1.2 Cutie Pie Measurements

Measurements were made throughout the cell: all <1 mrad/h.

B.1.1.3 Reuter-Stokes Ion Chamber Measurements

Measurements were made at three locations in the cell: range from 10.2 to 11.5 μR/h.

B.1.2 DIRECT AND SMEAR MEASUREMENTS

B.1.2.1 G-M with P-11 Probe

Measurements:

- <200 to 2,000 cpm direct
- <200 to 300 cpm smears.

B.1.2.2 PAM

Measurements:

- <220 to 245,000 d/m direct
- <220 to 49,000 d/m smear.

B.1.3 ESTIMATED INVENTORIES

Estimated inventories for the primary radioisotopes detected in A cell are listed in table B-1.

Table B-1. A Cell Inventory Estimate.

Category	Radionuclide[a]				
	^{239}Pu	^{241}Am	^{137}Cs	^{90}Sr	^{60}Co
Dust	8.4 E-03	6.4 E-04	1.7 E-04	3.8 E-04	6.4 E-05
Gutter/sump sampler box	2.9 E-04	2.2 E-05	6.0 E-06	1.4 E-05	2.3 E-06
Equipment					
Tank A-1	3.9 E-02	3.0 E-03	8.1 E-04	1.8 E-03	3.0 E-04
Tank A-3	3.9 E-02	3.0 E-03	8.1 E-04	1.8 E-03	3.0 E-04
Tank A-4	1.3 E-02	1.0 E-03	2.7 E-04	6.1 E-04	1.0 E-04
Centrifuge -2	4.5 E-01	3.4 E-02	9.2 E-03	2.1 E-02	3.5 E-03
Piping	2.2 E-01	1.7 E-02	4.6 E-03	1.0 E-02	1.7 E-03
Totals	7.7 E-01 (13 g)	5.9 E-02	1.6 E-02	3.6 E-02	6.0 E-03

[a]In curies unless noted.

B.2.0 B CELL DATA

B.2.1 DOSE/EXPOSURE RATES

B.2.1.1 Snoopy Measurements

Measurements were taken at six locations adjacent on the ground floor: all <0.3 mrem/h.

Measurements were taken in two locations on the centrifuge deck: both measurements <0.1 mrem/h.

B.2.1.2 Cutie Pie Measurements

Measurements were made throughout the cell: all <1 mrad/h.

B.2.1.3 Reuter-Stokes Ion Chamber Measurements

Measurements were made at four locations in the cell: range from 10.0 to 13.3 μR/h.

B.2.2 DIRECT AND SMEAR MEASUREMENTS

B.2.2.1 G-M with P-11 Probe

Measurements:

- <200 to 1,000 cpm direct
- <200 cpm smear.

B.2.2.2 PAM

Measurements:

- <220 to 200,000 d/m direct
- <220 to 21,000 d/m smear.

B.2.3 ESTIMATED INVENTORIES

Estimated inventories for the primary radioisotopes detected in B cell are listed in table B-2.

Table B-2. B Cell Inventory Estimate.

Category	Radionuclide[a]				
	^{239}Pu	^{241}Am	^{137}Cs	^{90}Sr	^{60}Co
Dust	6.0 E-03	4.6 E-04	2.6 E-04	1.9 E-04	9.5 E-05
Gutter/sump sampler box	2.9 E-04	2.2 E-05	7.4 E-06	5.4 E-06	2.7 E-06
Piping	2.2 E-01	1.7 E-02	4.9 E-03	3.6 E-03	1.8 E-03
Equipment					
Tank B-1	1.9 E-01	1.2 E-02	5.1 E-04	3.8 E-04	1.9 E-04
Tank B-3	1.9 E-01	1.2 E-02	5.1 E-04	3.8 E-04	1.9 E-04
Tank B-4	7.9 E-02	6.0 E-03	2.6 E-04	1.9 E-04	9.4 E-05
Tank B-6	7.9 E-02	6.0 E-03	2.6 E-04	1.9 E-04	9.4 E-05
Centrifuge B-2	4.5 E-01	3.4 E-02	1.5 E-03	1.1 E-03	5.3 E-04
Totals	1.2 E+00 (20 g)	8.8 E-02	8.2 E-03	6.0 E-03	3.0 E-03

[a]In curies unless noted.

B.3.0 C CELL DATA

B.3.1 DOSE/EXPOSURE RATES

B.3.1.1 Snoopy Measurements

Measurements were taken at five locations in the cell: all <0.1 mrem/h.

B.3.1.2 Cutie Pie Measurements

Measurements were made throughout cell: <1 mrad/h on ground level
<3 mrad/h in pit and tunnel.

B.3.1.3 Reuter-Stokes Ion Chamber Measurements

Measurements were made at two locations on the main floor: both <20 μR/h.

Measurements were made at three locations in the pit and tunnel: range from <50 to 66 μR/h.

B.3.2 DIRECT AND SMEAR MEASUREMENTS

B.3.2.1 G-M with P-11 Probe

Measurements:

- <200 to 500 cpm direct
- <200 to 300 cpm smear.

B.3.2.2 PAM

Measurements:

- <220 to 315,000 d/m direct
- <220 to 7,000 d/m smear.

B.3.3 ESTIMATED INVENTORIES

Estimated inventories for the primary radioisotopes detected in C cell are listed in table B-3.

Table B-3. C Cell Inventory Estimate.

Category	Radionuclide[a]				
	^{239}Pu	^{241}Am	^{137}Cs	^{90}Sr	^{60}Co
Dust	5.7 E-03	4.3 E-04	3.6 E-04	2.5 E-02	4.9 E-03
Gutter/sump sampler box	5.0 E-04	3.8 E-05	2.2 E-04	1.6 E-02	3.0 E-03
Piping	2.8 E-01	2.1 E-02	6.1 E-03	4.3 E-01	8.4 E-02
Equipment					
Tank C-4	3.8 E-01	2.9 E-02	4.2 E-02	3.0 E+00	5.7 E-01
Tank C-7	5.0 E-01	3.8 E-02	5.5 E-02	3.9 E+00	7.5 E-01
Tank C-8	1.1 E+00	8.3 E-02	1.2 E-01	8.4 E+00	1.6 E+00
Tank C-9	3.8 E-01	2.9 E-02	4.2 E-02	3.0 E+00	5.7 E-01
Pit walls	3.8 E-01	2.9 E-04	3.4 E-05	2.7 E-03	1.4 E-04
Totals	2.7 E+00 (44 g)	2.0 E-01	2.7 E-01	1.9 E+01	3.6 E+00

[a]In curies unless noted.

B.4.0 D CELL DATA

B.4.1 DOSE/EXPOSURE RATES

B.4.1.1 Snoopy Measurements

Measurements were taken at seven locations adjacent to the tanks and centrifuge: all <0.1 mrem/h.

B.4.1.2 Cutie Pie Measurements

Measurements were made throughout the cell: all <1 mrad/h.

B.4.1.3 Reuter-Stokes Ion Chamber Measurements

Measurements were made at two locations in the cell: range from 15 to 18 μR/h.

B.4.2 DIRECT AND SMEAR MEASUREMENTS

B.4.2.1 G-M with P-11 Probe

Measurements:

- <200 to 100,000 cpm direct
- <200 to 9,000 cpm smear.

B.4.2.2 PAM

Measurements:

- <220 to 280,000 d/m direct
- <220 to 140,000 d/m smear.

B.4.3 ESTIMATED INVENTORIES

Estimated inventories for the primary radioisotopes detected in D cell are listed in table B-4.

Table B-4. D Cell Inventory Estimate.

Category	Radionuclide[a]				
	^{239}Pu	^{241}Am	^{137}Cs	^{90}Sr	^{60}Co
Dust	2.1 E-03	1.6 E-04	1.3 E-04	1.6 E-03	1.8 E-04
Gutter/sump sampler box	2.9 E-03	2.2 E-04	1.8 E-05	2.2 E-04	2.5 E-05
Piping	2.2 E-01	1.7 E-02	4.9 E-03	5.9 E-02	6.9 E-03
Equipment					
Tank D-1	3.7 E-01	2.8 E-02	1.6 E-03	2.0 E-02	2.3 E-03
Tank D-3	7.4 E+00	3.4 E+00	1.1 E-03	1.3 E-02	1.5 E-03
Tank D-4	1.3 E-01	1.0 E-02	5.8 E-04	7.0 E-03	8.1 E-04
Centrifuge D-2	4.5 E-01	3.4 E-02	2.0 E-03	2.4 E-02	2.8 E-03
Totals	8.6 E+00 (140 g)	3.5 E+00	1.0 E-02	1.2 E-01	1.5 E-02

[a]In curies unless noted.

B.5.0 E CELL DATA

B.5.1 DOSE/EXPOSURE RATES

B.5.1.1 Snoopy Measurements

Measurements were taken at seven locations adjacent to the tanks and centrifuge: all measurements were <0.1 mrem/h.

B.5.1.2 Cutie Pie Measurements

Measurements were made throughout the cell: all <1 mrad/h.

B.5.1.3 Reuter-Stokes Ion Chamber Measurements

Measurements were made at five locations in the cell: all <12.9.

B.5.2 DIRECT AND SMEAR MEASUREMENTS

B.5.2.1 G-M with P-11 Probe

Measurements:

- <200 to 20,000 cpm direct
- <200 to 800 cpm smear.

B.5.2.2 PAM

Measurements:

- <220 to 700,000 d/m direct
- <220 to 140,000 d/m smear.

B.5.3 ESTIMATED INVENTORIES

Estimated inventories for the primary radioisotopes detected in E cell are listed in table B-5.

Table B-5. E Cell Inventory Estimate.

Category	Radionuclide[a]				
	^{239}Pu	^{241}Am	^{137}Cs	^{90}Sr	^{60}Co
Dust	1.1 E-03	8.1 E-05	6.8 E-05	8.5 E-05	9.5 E-06
Gutter, Sump, Sample Box	2.9 E-04	2.2 E-05	1.9 E-05	2.4 E-05	2.7 E-06
Piping	2.2 E-01	1.7 E-02	4.9 E-03	6.2 E-03	6.8 E-04
Equipment					
Tank E-1	1.3 E-02	1.0 E-03	7.6 E-04	9.5 E-04	1.1 E-04
Tank E-3	1.3 E-02	1.0 E-03	7.6 E-04	9.5 E-04	1.1 E-04
Tank E-4	1.8 E-01	1.4 E-02	1.1 E-02	1.3 E-02	1.5 E-03
Centrifuge E-2	4.5 E-01	3.4 E-02	2.6 E-02	3.3 E-02	3.6 E-03
Total	8.8 E-01 (14 g)	6.7 E-02	4.4 E-02	5.4 E-02	6.0 E-03

[a]In curies unless noted.

B.6.0 F CELL DATA

B.6.1 DOSE/EXPOSURE RATES

B.6.1.1 Snoopy Measurements

Measurements were taken at five locations around F cell: all <0.1 mrem/h.

B.6.1.2 Cutie Pie Measurements

Measurements were made throughout F cell: all <1 mrad/h.

B.6.1.3 Reuter-Stokes Ion Chamber Measurements

Measurements were taken at five locations in the cell: range from 18 to 24 μR/h.

B.6.2 DIRECT AND SMEAR MEASUREMENTS

B.6.2.1 G-M with P-11 Probe

Measurements:

- 200 to 20,000 cpm direct
- 200 to 900 d/m smear

B.6.2.2 PAM

Measurements:

- 200 to 700,000 d/m direct
- 200 to 600,000 smear

B.6.3 ESTIMATED INVENTORIES

Estimated inventories for the primary radioisotopes detected in F cell are listed in table B-6.

Table B-6. F Cell Inventory Estimate.

Category	Radionuclide[a]				
	^{239}Pu	^{241}Am	^{137}Cs	^{90}Sr	^{60}Co
Dust	1.1 E-03	8.4 E-05	4.0 E-05	7.9 E-05	3.0 E-07
Gutter, Sump Sample Box	5.8 E-04	4.4 E-05	2.1 E-05	4.1 E-05	1.6 E-07
Piping	2.8 E-01	2.1 E-02	7.0 E-03	1.4 E-02	5.3 E-05
Equipment					
Tank F-1	8.0 E-01	6.1 E-02	3.1 E-02	6.0 E-02	2.3 E-04
Tank F-7	8.0 E-01	6.1 E-02	3.1 E-02	6.0 E-02	2.3 E-04
Tank F-8	8.0 E+00	6.1 E-01	3.1 E-01	6.0 E-01	2.3 E-03
Tank F-9	6.2 E+00	4.7 E-01	2.4 E-01	4.6 E-01	1.8 E-03
Loadout hood	8.9 E-03	6.8 E-04	1.9 E-08	--	--
Centrifuge F-2	4.5 E-01	3.4 E-02	1.7 E-02	3.4 E-02	1.3 E-04
Centrifuge F-22	4.5 E-01	3.4 E-02	1.7 E-02	3.4 E-02	1.3 E-04
Total	1.7 E+01 (277 g)	1.3 E+00	6.5 E-01	1.3 E+00	<5.0 E-03

[a]In curies unless noted.

APPENDIX C

RESOURCE REQUIREMENTS

This appendix is a compilation of the resources needed for the 224-B decommissioning project. The resource categories addressed are staff, materials, and tools and equipment.

C.1 STAFF REQUIREMENTS

In order to maintain a continuous D&D program, there is an attempt to maintain a level manpower load of D&D workers. Additional crafts that support D&D work are needed occasionally, and are needed to support other programs. Therefore, the scheduling of work is controlled by the number of D&D workers; other manpower needs are scheduled around these. Figure C-1 depicts the estimated manpower requirements by job type for the duration of the 224-B decommissioning project.

C.2 EQUIPMENT REQUIREMENTS

Table C-1 lists equipment requirements for the duration of the 224-B decommisssioning project.

Table C-1. Equipment Requirements for 224-B Decommissioning Project. (Sheet 1 of 2)

	Available on site	Requires fabrication modification	Need to procure
Cell ventilation system	X	X	X
1000 CFM exhauster (HEPA)			X
HEPA-filtered vacuum	X		X
Waste transport truck	X		
Tank truck	X		
Front end loader/backhoe	X		
Spider staging	X		X
Portable scaffolding	X		
Ladders	X		
Portable hoist	X		
High pressure wash system			X

Table C-1. Equipment Requirements for 224-B Decommissioning Project.
(*Sheet 2 of 2*)

	Available on site	Requires fabrication modification	Need to procure
Omnidirectional spray head			X
Submersible pump			X
Centrifugal pump			X
Concrete saw	X		
Chipping hammers	X		
Portable band saw	X		
Reciprocating saw	X		
Circular saw	X		
Hydraulic crimper/cutter	X		
Hand saws	X		
Wrenches	X		
Hammers	X		
Wrecking bars	X		
Drill	X		
Nibbler	X		
Shovels	X		
Brooms	X		
Dustpans	X		
Mops	X		
Utility knives	X		
Safety harness	X		
NDA system	X		
Continuous air monitors	X		
Thermoluminescent dosimeters	X		
Radiation survey instruments	X		

C.3 MATERIAL REQUIREMENTS

Material requirements for the 224-B decommissioning project include the following:

- Plastic
- Tape
- 55-gal drums
- 55-gal galvanized drums (TRU)
- Low-level waste cartons
- TRU burial boxes
- Decontamination chemicals
- Sweeping compounds
- Foam sealant
- Rags/smears
- Paint
- Rigging
- 3-gal jug
- Framing lumber
- Plywood
- Grating
- Concrete
- Roof vents
- Nails
- Replacement doors
- Gaskets
- Blind flanges
- Tank exhauster transition piece
- Tank sprayer connector
- Containment bag (critically safe)

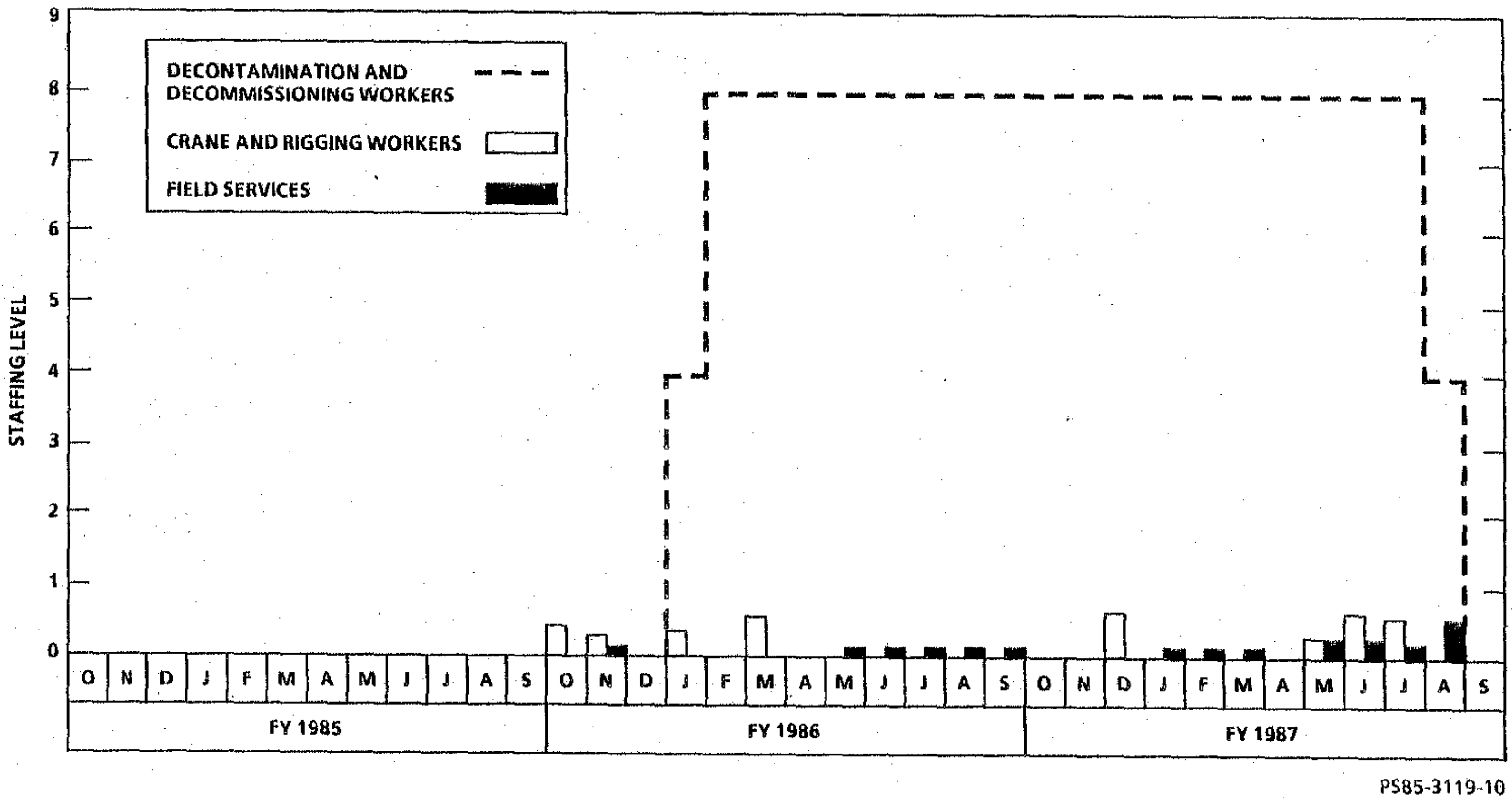

Figure C-1. Manpower Requirements (monthly average). (sheet 1 of 3)

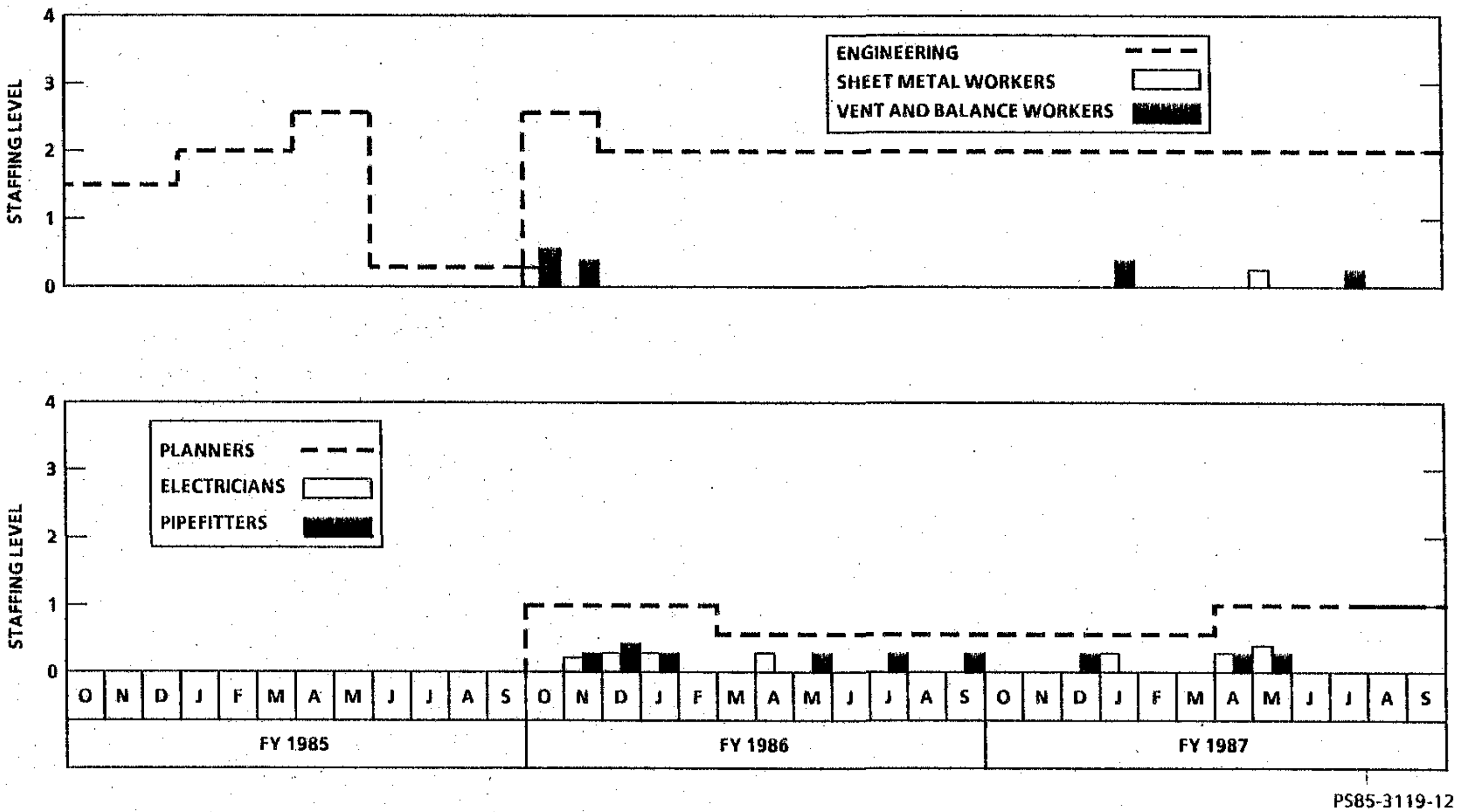

Figure C-1. Manpower Requirements (monthly average). (sheet 2 of 3)

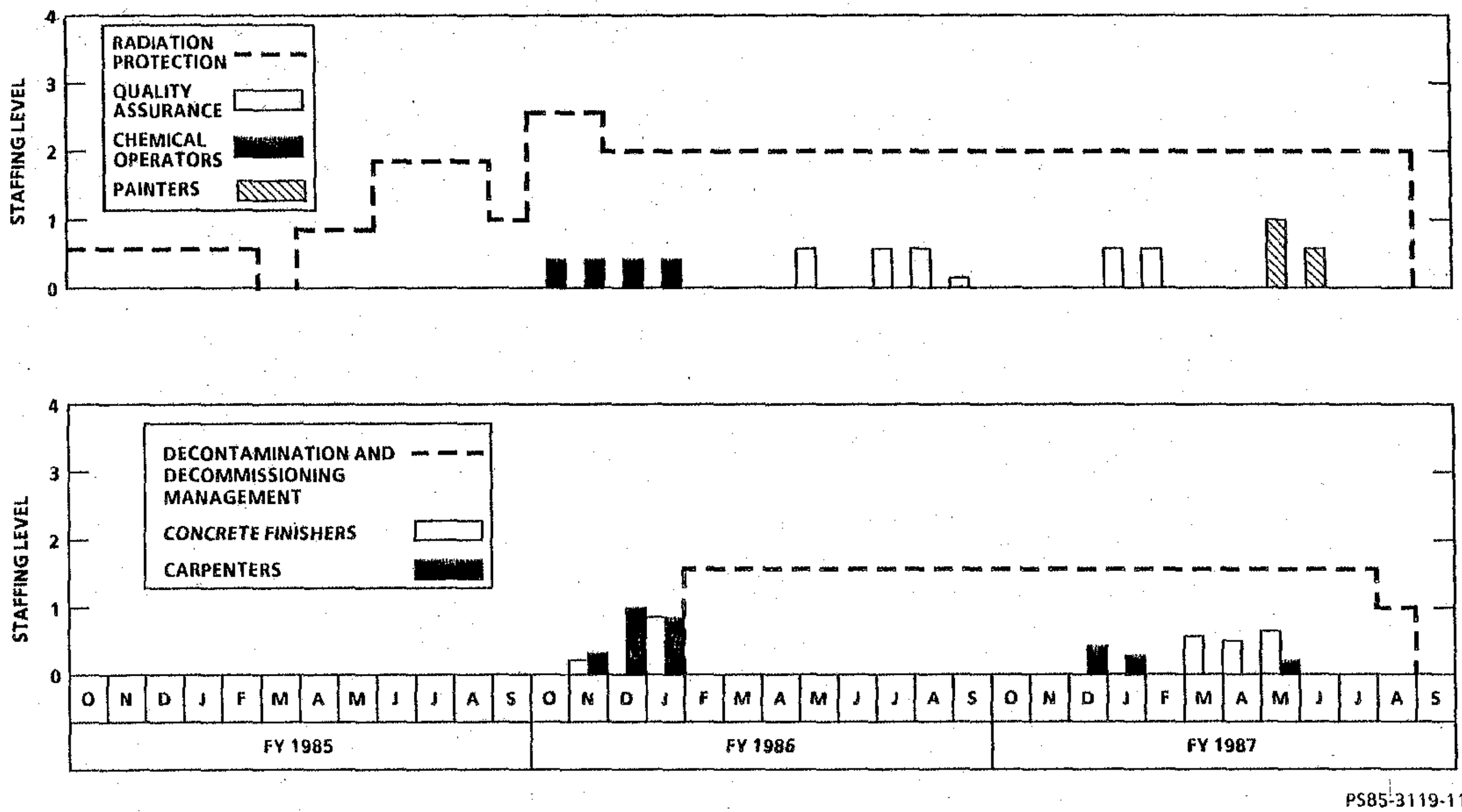

Figure C-1. Manpower Requirements (monthly average). (sheet 3 of 3)

APPENDIX D

CHEMICALS USED DURING 224-B OPERATION

INPUT CHEMICAL

$BiPO_4$	Bismuth Phosphate
$NaBiO_3$	Sodium metabismuthate
$Na_2Cr_2O_7 \cdot 2H_2O$	Sodium chromate
H_3PO_4	Phosphoric acid
HNO_3	Nitric acid
$La(NO_3)_5 \cdot 2NH_4NO_3 \cdot 4H_2O$	Lanthanum ammonium nitrate
$H_2C_2O_42H_2O$	Oxalic acid
HF	Hydrogen fluoride
KOH	Potassium hydroxide
$KMnO_4$	Potassium permanganate

WASTE SOLUTIONS

$BiPO_4$	Bismuth phosphate
HNO_3	Nitric acid
LaF_3	Lanthanum fluoride
KOH	Potassium hydroxide
H_3PO_4	Phosphoric acid
$NaNO_3$	Sodium nitrate
KNO_3	Potassium nitrate
$Cr(NO_3)_3$	Chromium nitrate
HF	Hydrogen fluoride
$H_2C_2O_4 \cdot 2H_2O$	Oxalic acid
$Mn(NO_3)_2$	Magnesium nitrate
NH_4NO_3	Ammonium nitrate
KF	Potassium nitrate
Fission products	

APPENDIX E

MERCURY SURVEY REPORTS

HANFORD ENVIRONMENTAL HEALTH FOUNDATION

CO 9515

February 22, 1985

Rockwell Hanford Operations
222-T Building, 200-W Area

Attn: M. L. Rosbach

MERCURY SURVEY, 224-B BUILDING, 200-E AREA

On February 15, 1985, a survey was conducted in the third floor operating gallery area of the 224-B Building to assess the adequacy of cleanup of a small mercury spill. Reportedly, approximately 5 cc of elemental mercury was found on the top surface of a wooden packing crate located near the third floor elevator. The spill was cleaned up by use of a commercial mercury cleanup kit.

Measurements made by use of a J-W Model MV-2 mercury sniffer indicated that general mercury vapor levels in the gallery area were nondetectable (detection limit = 0.01 mg/m^3) while a visual inspection of gallery area surfaces revealed an absence of visible mercury droplets. However, by scuffing the surface of the subject crate, significant concentrations (approximately 0.2 to 0.7 mg/m^3) could be generated and detected approximately 6 inches above the surface. This condition could be duplicated on nearby floor surfaces and on floor surfaces below the deactivated control panels, but to a lesser extent.

Discussion of Findings

The third floor gallery area of the 224-B Building is a normally unoccupied space which is apparently being used as storage for miscellaneous equipment and materials. In view of the general absence of mercury vapor and limited and infrequent occupancy of the space, employee exposures to mercury vapor are not anticipated.

Recommendations

The ability to mechanically generate mercury vapor by scuffing the surface indicates the presence of residual mercury contamination. Such residual contamination even after cleanup is typical of mercury spills, especially where porous surfaces are involved (wood, unpainted concrete, carpets, etc.), and is not necessarily indicative of an inadequate cleanup effort. However, as a prudent industrial hygiene practice, residual mercury contamination should be

P. O BOX 100, RICHLAND, WASHINGTON 99352

reduced to the lowest extent practicable. In this case, a thorough wet mopping of floor surfaces should be conducted to remove accumulated dust. Such dusts can entrain residual mercury contamination as well as coat and disguise mercury droplets. In addition, the subject packing crate is judged to be sufficiently contaminated to warrant its immediate disposal. The crate should be contained in plastic and disposed of via conventional means.

Should you have any questions concerning this report, please contact me.

C. H. St. John
Environmental Health Sciences

jt

HANFORD ENVIRONMENTAL
HEALTH FOUNDATION

March 21, 1985 9593

Rockwell Hanford Operations
222-T Building
200-W Area

Attn: Lynn Kupferschmid

SURVEY FOR MERCURY, 224-B BUILDING, 200-E AREA

As requested, areas on and around the main "F", small "F", and "G" panel boards located on the 2nd floor of the 224-B Building have been surveyed for elemental mercury (Hg) contamination. The survey conducted March 19, 1985, indicated the presence of trace amounts of residual mercury on floor surfaces near the front of the main "F" panel board. Airborne mercury vapor concentrations in all areas were less than the detection limit of the survey instrument[1] of 0.005 mg/m^3 and no visible mercury droplets were observed.

Low level residual mercury contamination is typical in areas having a history of mercury use and is not necessarily indicative of a potential health hazard. In this instance, the trace levels should pose no threat to employee health nor require any remedial action.

Should you have any questions concerning this matter, please contact Environmental Health Sciences.

C. H. St. John
Environmental Health Sciences

spm

[1] J. W. Model MV-2 mercury sniffer.

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APPENDIX F

TANK STRUCTURAL ANALYSIS

Find the maximum weight of scrap that can be lifted in various tanks. Assume that the scrap is in large pieces so it will not flow like liquid or a granular material. Then, only the bottom of the cylindrical tanks will be loaded and the capacity will be governed by:

- Strength of the bottom plate of the tank. The edges are restrained by the cylinder, but not clamped. The edge moments will be less than the clamped case, and the center moment will be less than the simply supported case.

- Strength of the cylindrical shell. Assuming no internal pressure, the only load will be the moment at the edge of the bottom plate. This is maximum at the bottom of the shell and reduces exponentially to zero. There will also be a small tension caused by the vertical loading that can be added to the bending stress.

- Strength of the lifting leg.

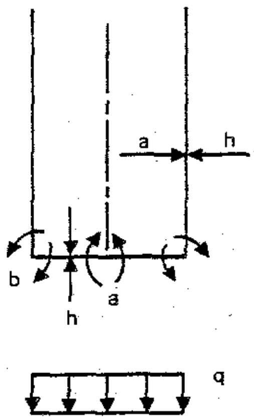
Drawings show steel to be 25-12Cb (DuPont SPEC 322-4-1 Grade 820-B, HW 3075 SS 1 Grade 820B, etc.,). These are assumed similar to type 309 S, with a minimum yield strength of 30 KSI (ASTM A240). Mills typically produce this with an actual yield >44 KSI. Use 20 KSI working stress for a minimum factor safety of 1.5 against yield. Actual factor of safety is much higher due to conservative analysis. Factor of safety against failure is even greater since low-yield point steels are ductile and strain hardening.

REFERENCES

AISC, 1980, Manual of Steel Construction, American Institute of Steel Construction, Chicago, Illinois.

Timoshenko, S. and Woinowsky-Krieger, S, 1959, Theory of Plates and Shells, McGraw-Hill Book Company, New York, New York.

F.1 MINIMUM YIELDING NET LOADS



at a: $\sigma = \frac{3}{8}(3 + \nu^{*})\frac{a^2}{h^2}$

q is maximum stress in simply supported plate (ref. 1)
$^{*}\nu = .25$

at b: $\sigma = \frac{3}{4}\frac{a^2}{h^2}$

q is maximum bending stress in clamped plate (ref. 1)

σ (in cylinder = $\sigma + \frac{\pi a^2 q}{2ah} = \frac{a}{h}\left(\frac{3}{4}\frac{a}{h} + \frac{1}{2}\right)q$

Normally, σ at the center simply supported the plate; greater stress exists at the edge of the clamped plate, so at b, only the shell stress must be checked.

Find minimum q from a or b, then reduce it by the weight of the bottom plate to find net q, then multiply by the bottom area for net weight. Assume an allowable stress of 30,000 psi using:

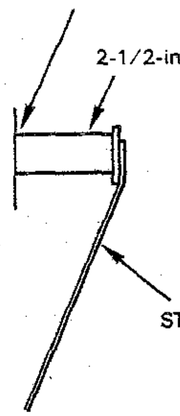
$$q = \frac{30,000}{\frac{3}{8}(3 + \nu)\frac{a^2}{h^2}} \text{ or } \frac{30,000}{\frac{a}{h}(\frac{3}{4}\frac{a}{h} + \frac{1}{2})}$$

a	h	a/h	Allowable weight[1]
$\frac{4 \text{ ft-6 in.}}{2}$ = 27 in. (Drawing HD62486)	.25 in.	108	2.11 psi or 3.408 2.11 x 144 = 304 psf less 10.2 psf (ref. 2) W = 294 psf x $\pi(2.25)^2$ = **4,676 lb net**
$\frac{4 \text{ ft-0 in.}}{2}$ = 24 in. (Drawing HD62494)	.25 in.	96	2.671 psi or 4.310 2.671 x 144 = 385 psf less 10.2 psf W = 375 x $\pi(2)^2$ = **4,712 lb net**
$\frac{4 \text{ ft-6 in.}}{2}$ = 27 in. (DET 62002)	.375 in.	72	4.748 psi or 7.645 4.748 x 144 = 684 psf less 10.2 psf 669 x $\pi(2.25)^2$ = **10,640 lb net**
$\frac{9 \text{ ft-0 in.}}{2}$ = 54 in. (Drawing HD62372)	.375 in.	144	1.187 psi or 1.92 1.187 x 144 = 171 psf less 15 psf 156 x $\pi(4.5)^2$ = **9,924 lb net**

Note: [1]Multiply above loads by 2/3 for a minimum factor of safety of 1.5 against yielding.

F.2 LIFTING LUG STRENGTH

Trunnions or lugs must carry tank weight plus net weight. Details are similar for the three tanks. Drawing H062494 shows no trunnions on the 4 ft by 5 ft tank.



Strap strength: 5/8 x 2 1/2 x 20,000 psi = 31,250 lb with sufficient weld at trunnion and jacket.

1/4 in. fillet weld strength: 20,000 psi x 1/4x.707 = 3,535 lb/in. length.

The trunnion-tank connection is not long enough for bending strength consideration.

The trunnion is not long enough for bending strength consideration.

When hooking to both trunnions, the capacity of the tank is governed by the bottom plate, not the trunnions.